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STUDIES IN BORAGINACEAE, X
THE BORAGINACEAE OF NORTHEASTERN SOUTH AMERICA

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THE present paper is a critical account of the Boraginaceae known from British, Dutch and French Guiana and the adjoining portions of Brazil, north and east of the Amazon and the Rio Negro. A general account, it is preliminary to a treatment of the Dutch Guianan species of the family which Prof. A. A. Pulle has invited me to prepare for his "Flora of Surinam."

The borages of the Guianas have been long neglected. Such fragmentary work as has been done on them has been restricted to the narrow political boundaries. Though various species of the group have been described from the Guianas, some of them among the first based upon South American material, the identity of the types has remained obscure, and material in herbaria has continued to be named largely by guess or has been left to accumulate unidentified. The great reference works, such as DeCandolle's Prodromus, or Martius's Flora Brasiliensis, resolve little of the confusion that seems always to have enveloped our knowledge of the Guianan Boraginaceae. They added little to the observations all ready long available in the writings of Lamarck and Poiret. Indeed, so little known and confused were the Guianan species of *Cordia* and *Tournefortia*, that a few years ago, during my studies of the Brazilian species of these genera, Contr. Gray Herb. 92: 1–89 (1930), I was forced to pass over, undiscussed, the very evident relations existing between the species of the Guianas and those of northern Brazil, and forced to admit that certain of the obscure species (several of them not even listed in the Index Kewensis) might be identical and older than the ones I was forced to accept. A careful study of the Guianan Boraginaceae has been long needed.

The conspicuous relationship evident among the Guianan Boraginaceae is that with Brazil, most of the species extending into and about the Amazon Basin or having their immediate relatives there. The affinities westward in Venezuela are not so numerous nor so pronounced. Except for Trinidad (which after all is floristically close to that of eastern Venezuela) direct relations to the northward are negligible. Among the Guianan Boraginaceae only the group *Cordia* § *Pilicordia* has developed any number of local species. The relations of these local endemics are in the Amazon Basin where the species of this group are not local but widely distributed. The Guianas are a marked endemic center for *Pilicordia* comparable with the centers of that group found in southeastern Brazil, northern Venezuela and adjacent Colombia, and the West Indies.

I have treated in this paper all the borages known north and east of the Amazon, the Rio Negro and the eastern boundary of Venezuela. The monotypic *Lepidocordia* is endemic to this area. Of the 38 species definitely known from this large area only two, *Cordia multispicata* and *Cordia naidophila* are at present unknown from British, Dutch or French Guiana. Several other species approach our area, reaching the Orinoco Valley from the westward. Among these species those which may eventually be found in northwestern British Guiana are *Cordia globosa* (Jacq.) HBK., *Cordia alba* Jacq. and *Bourreria cumanensis* (Loefl.) O. E. Schulz. The writings of Schomburgk, Aublet and others have listed various West Indian species from the Guianas. Some of these records are evidently based upon misidentifications, others, however, I am convinced, are simply unfortunate guesses as to what the authors believed might be found there. Most of these questionable records relate to species common and widespread at low altitudes in the Antilles. This group of plants is poorly represented on the Guianan coastal area, probably because of adverse winds and currents and the unfavorably humid conditions.

In the preparation of this report I have examined practically all the types concerned and have studied most of the large or important Guianan collections in Europe and United States. Studies have been made at Kew, London, Leiden, Utrecht, Copenhagen, Berlin, Munich, Geneva and Paris. Large loans of critical material have been obligingly sent for further, more leisurely study at the Arnold Arboretum and the Gray Herbarium from Kew, London, Leiden, Utrecht, Berlin, Paris and New York. Particular mention, however, is to be made of the large loan from the Botanical Museum at Utrecht. This material, assembled through the inspiration of Prof. Pulle and kindly made available to me

by him, consists of numerous series of copious specimens collected over a number of years, at different seasons, from various numbered individual trees or shrubs, in the Forest Reserves of Dutch Guiana. Through the examination of this remarkable record of seasonal variation I have been able to establish unquestionably the specific identity of certain seasonal forms heretofore troublesome to identify. Of great help in the preparation of this report the collections have been generally instructive to me personally. It has been a privilege to have such a convincing demonstration of the nature and extent of seasonal variation in individual trees and shrubs of the Tropics.

The following abbreviations have been used in designating the source of the material cited. B. W. — collections by the Forest Service (Boschwezen) of Dutch Guiana; AA — Arnold Arboretum; BD — Botanical Museum at Berlin; BM — British Museum of Natural History; DC — Prodromus Herbarium of DeCandolle at Geneva; Del — Delessert Herbarium at Geneva; G — Gray Herbarium; K — herbarium at Kew; Leid — herbarium at Leiden; NY — New York Botanical Garden; US — U. S. National Herbarium; Utr — Utrecht Herbarium.

KEY TO THE GENERA

Stigmas 2 or 4, simple; inflorescence cymose-paniculate or spicate or globose, the branches not distinctly scorpioid; erect broad-leaved trees and shrubs.
  Stigmas 4, capitate or clavate, borne on a conspicuous slender, twice lobed or cleft style ..... 1. *Cordia*, p. 3.
  Stigmas 2, conic, sessile on the apex of the ovary, short and inconspicuous ..... 2. *Lepidocordia*, p. 45.
Stigma 1, consisting of an anulate fertile base and a more or less developed sterile frequently bifid apical portion; inflorescence with distinctly scorpioid branches or the flowers cauline and solitary in the internodes.
  Fruit baccate; clambering shrubs ..... 3. *Tournefortia*, p. 46.
  Fruit dry; herbs or small suffrutescent plants .. 4. *Heliotropium*, p. 57.

1. Cordia [Plumier] Linnaeus, Gen. 87 (1754).

Trees or shrubs, usually with broad leaves. Inflorescence a loosely paniculate or glomerate or capitate or spicate cyme. Calyx usually 5-toothed or 5–10-lobed, usually persistent. Corolla white, yellow or reddish, small to conspicuous, usually 5-merous, rarely 6–15-merous, salverform or subrotate to funnelform or subtubular. Stamens as many as the corolla-lobes, exserted or included, filaments short or long. Ovary 4-celled, ovules 1–4. Style terminal, well developed, 2-lobed or 2-parted, the branches each 2-lobed. Stigmas 4, capitate or clavate, small. Fruit unlobed, a drupe with a bony pit and mucilaginous or dry exocarp, or

the walls dry and papery, 1–4-celled. Endosperm none. Cotyledons plicate.

A very large genus of diverse habit and structures; widely distributed throughout the Tropics. Centering in America. Type Species: *C. sebestena* L.

On the grounds that the original *"Cordia"* of Plumier, Nov. Pl. Amer. Gen. 13, tab. 14 (1703), which was accepted and validated by Linnaeus, is not a member of the Boraginaceae, the generic name *Cordia* has been recently discarded for the present concept by Dr. von Friesen, Bull. Soc. Bot. Genève, sér. 2, **24**: 131–4 (1933). With this I can not agree. It is pointed out by von Friesen that Plumier's illustration shows a 2-celled ovary and a simply bifid style and that the generic description of *Cordia* (based upon Plumier's plate and description) given by Linnaeus in the Genera Plantarum of 1754, pg. 87, also calls for these structures. Dr. von Friesen believes they are structures of some genus outside of the Boraginaceae. I believe they are structures of *Cordia sebestena* faultily described from inaccurate drawings.

I have had the privilege of studying, in the library of the Natural History Museum at Paris, the amazing series of volumes of plates and manuscripts accumulated by Plumier during his visits (1689–97) to the West Indies. In one of these volumes of manuscript, **6**: tab. 64–66, are found fine drawings labeled *"Cordia nucis iuglandis folio, flore purpureo."* The best of these original drawings, made in the West Indies by Plumier, fills a folio page and shows a characteristic branch of *Cordia sebestena* bearing leaves, flowers and fruit. In the corner of the page are the details of flower and fruit, differing only in arrangement from those printed in Plumier's Genera. The structures of style and ovary are quite alike in both. This may be verified by a comparison of the small plate in Plumier's Genera and the good copy of the original folio plate published in Burmann's edition of Plumier's Plantarum Americanarum, fasc. 5, tab. 105 (1757). The later plate is identified as *C. sebestena* by Urban, Rep. Spec. Nov. Beiheft **5**: 60 (1920). Von Friesen, l. c. 135, however, believes that only the leafy, flower-bearing branch is *C. sebestena* and that the disputed unattached analytic details belong to some other genus. Since, however, the disputed details are an integral part of the original drawing of Plumier, which consists mainly of a flowering and fruiting branch unquestionably of *C. sebestena,* and since the details, as far as one can compare them, are quite like homologous structures shown growing attached to the flowering and fruiting branch of *C. sebestena,* I feel there is every reason for believing that, however inaccurate, they were intended to show the structures of that species.

It is to be recalled that Plumier's drawings were made long before the work of Linnaeus on the Sexual System directed particular attention and gave special importance to the number and structure of the internal parts of the flower and fruit. Plumier, and Linnaeus who copied from him, may have given erroneous descriptions of the fruit and style of *Cordia sebestena* but since they were trying to describe that species I believe we should retain their name for the genus containing it.

Plumier's drawing was made on the island of St. Thomas. The following quotation from his manuscript gives the type-locality of *C. sebestena* in some detail. "Martio plantarum florentem frutusque maturos ferentem adinveni apud insulam Sancti Thomae, juxta Littus quoddam La Baye du nord vocitatum, sinum scilicet ad septenttrionalem plagam ipsi Arci oppositum."

Key to the Species

Corolla marcescent; fruit cylindrical, dry, with a fibrous chartaceous coat, not bony, closely invested by the tube of the persistent corolla and the strongly ribbed cylindrical calyx, at maturity flower disarticulating from the inflorescence and the calyx and corolla and the enclosed fruit falling away together, with the spreading corolla-lobes acting as a parachute; pubescence stellate; axis of inflorescence usually tunnelled or inflated and inhabited by ants ..... 1. *C. alliodora.*

Corolla withering after anthesis and soon deciduous; fruit usually baccate, with a bony ovoid or globose stone; pubescence simple.

Corolla red or orange, large; calyx becoming fleshy and completely enveloping the dry fruit and even adnate to it ..... 2. *C. sebestena.*

Corolla white or yellow; fruit juicy, not adnate to the dry calyx.

Corolla-lobes longer than broad; calyx explanate at maturity; inflorescence usually large and loosely branched; trees or shrubs with usually horizontal branches and flat tops.

Petioles of well developed leaves 15–40 (usually 20–30) mm. long; ovary and fruit glabrous; inflorescences terminating leafy branchlets.

Leaves glabrous and lustrous above, 15–40 cm. long; calyx ca. 5 mm. long; stone obliquely ovoid, ca. 18 mm. long; explanate calyx 10–13 mm. broad ..... 3. *C. fallax.*

Leaves strigose and rather dull above, 10–27 cm. long; calyx 2.5–3.5 mm. long; stone transversely compressed-ovoid, ca. 10 mm. long; explanate calyx 5–7 mm. broad ..... 4. *C. tetrandra.*

Petioles of well developed leaves 3–15 (usually 5–10)

mm. long; inflorescence usually borne at the forks of the dichotomous stems.

Ovary and style hairy; fruit mostly pubescent.

Leaves glabrous above or practically so; veins less conspicuously rebranched than in next; calyx usually apiculate, opening somewhat irregularly.

Stems with conspicuous subnodal swellings that serve as ant-domatia; calyx tending to disintegrate at maturity and showing a fibrous structure; plant usually conspicuously bristly .....5. *C. nodosa.*

Stems without subnodal swellings, not myrmecophilous; calyx not with fibrous structure; plant not bristly.

Fruit glabrous; calyx with a fine minute strigose-puberulence; lower leaf-surfaces glabrous or practically so .....6. *C. laevifrons.*

Fruit strigose; calyx strigose; lower leaf-surfaces pubescent.

Lower surfaces of leaves evidently bearing numerous erect slender hairs; inflorescence stiffish but loose and open...7. *C. Sprucei.*

Lower surfaces of leaves apparently glabrous, but really bearing scattered minute inconspicuous very short ascending hairs; inflorescence dense with short rigid crowded branches .....8. *C. nervosa.*

Leaves abundantly hairy above, veins repeatedly rebranched; calyx opening by 5 triangular lobes.

Calyx prominently and regularly 10-ribbed, 4–5 mm. long; fruit velvety, stone transversely ovoid .....9. *C. fulva.*

Calyx not ribbed, 2–4 mm. long.

Upper surface of leaves velvety, with very abundant slender erect or ascending hairs; leaves usually strongly dimorphic about the stem-forks (the normal elongate leaves usually opposed by much smaller suborbicular ones); fruit clothed with abundant slender appressed usually tawny hairs; stone ascending, ovoid .....10. *C. toqueve.*

Upper surface of leaves simply strigose or minutely scabrous; leaves homomorphic.

Lower surface of leaves green (drying brown), scabrid with very short sparse hairs; leaves lanceolate; fruit minutely strigose; stone ascending ovoid .....11. *C. scabrifolia.*

Lower surface of leaves pallid, with a felty covering of abundant appressed slender

hairs; leaves broadly lanceolate to ovate; fruit glabrescent; stone transversely ovoid .....12. *C. bicolor.*

Ovary, style, and fruit glabrous.

Lower surface of leaves pallid with a felty covering of abundant slender appressed hairs .....12. *C. bicolor.*

Lower surface of leaves not felty with a pallid indument.

Stone globose or depressed globose, quite rugose; calyx with abundant long slender hairs on the inner surface which project beyond the edge of the calyx-lobes and appear as a dense pale ciliation on their margins.

Calyx outside covered with abundant slender silky hairs; leaves rather thin, more or less dimorphic at the stem-forks, lower surface much paler than the upper .....13. *C. sericicalyx.*

Calyx sparsely strigose outside; leaves rigid, homomorphic, lower surface scarcely paler than upper .....14. *C. panicularis.*

Stone ovoid or ellipsoid, smooth, erect, elongate; calyx strigose on the inner surface, the hairs projecting beyond the calyx-lobes sparse and dark if present.

Hairs on lower leaf-surface erect.

Lower leaf-surface somewhat scabrid with minute stout hairs; leaves large, 15–28 cm. long, with evidently falcate midrib; branchlets with short erect hairs ...15. *C. Sagotii.*

Lower leaf-surface velvety with long slender hairs; leaves moderate-sized, 8–18 cm. long, midrib weakly falcate; branchlets brownish hirsute .....16. *C. hirta.*

Hairs on lower leaf-surface appressed.

Flower-buds elongate, obovoid, 4–5 mm. long; leaves 8–20 cm. long; inflorescence large and stiffish; Lower Amazon and the Guianas.

Leaf-blades broadest at or above middle, drying olivaceous or muddy brown .....17. *C. exaltata.*

Leaf-blades broadest at or below the middle drying a bright warm brown .....17a. var. *melanoneura.*

Flower buds subglobose, 2–3 mm. long; leaves 6–11 cm. long; inflorescence slender and usually small; Upper Amazon ...18. *C. naidophila.*

Corolla-lobes distinctly broader than long; calyx cupulate or cylindrical at maturity; inflorescence dense, globose or spicate, or exceptionally a small loose cyme; shrubs

with erect or ascending branches, frequently subscandent.
Corolla very large, 35–50 mm. long, the slender tube abruptly and much expanded into a coarse cylindrical throat; inflorescence capitate; tip of calyx-lobes conspicuously long-attenuate .....19. *C. grandiflora.*
Corolla small, about 5 mm. long or less, tube and throat weakly differentiated.
Inflorescence glomerate or cymose .....20. *C. polycephala.*
Inflorescence distinctly spicate.
Leaves not hairy above, merely more or less verrucose or muriculate, elongate; spikes terminal; petioles not decurrent on the peduncles .....21. *C. macrostachya.*
Leaves hairy above, strigose or velvety, broad; spikes axillary with the base of the petiole apparently decurrent on the subtended peduncle.
Calyx-lobes in bud lacking free tips; inflorescence becoming quite loosely flowered and elongate; upper surface of leaves strigose, somewhat lustrous .....22. *C. Schomburgkii.*
Calyx-lobes in the bud with projecting free tips; inflorescence dense and stout; upper surface of leaves with stiff erect or ascending hairs which arise from bulbous bases, surface not lustrous.
Calyx hairy all over, lobes narrowly triangular, long acuminate .....23. *C. tomentosa.*
Calyx with tube nearly glabrous, lobes broadly triangular, short acuminate .....24. *C. multispicata.*

1. **Cordia alliodora** (R. & P.) Chamisso ex DeCandolle, Prodr. **9**: 472 (1845); Johnston, Contr. Gray Herb. **92**: 13 (1930). *Cerdana alliodora* Ruiz & Pavon, Fl. Peruv. **2**: 47, tab. 184 (1799). *Cordia trichotoma* sensu Sandwith, Kew Bull. **1933**: 335 (1933).

Tree up to 20 m. tall; branchlets sparingly to densely stellate-pubescent; leaves oblong or lanceolate to elliptic, usually broadest at or above the middle, 3–8 cm. broad, 1–2 dm. long, base acute or obtuse, apex acuminate, margin entire, upper surface stellate-pubescent or glabrate, lower surface paler, stellate-tomentose or glabrescent, 5–7 pairs of veins, petiole 1–3 cm. long; inflorescence terminal, loosely and widely branched, 1–3 dm. thick, the flowers crowded on the branches, the axis commonly inflated, gall-like, irregular, usually serving as an ant-domatium; calyx cylindrical, with ten prominent ribs, densely stellate-tomentose, 4–6 mm. long, 2–2.5 mm. thick, lobes 5, inconspicuous; corolla white, drying brown, marcescent, lobes oblong, 5–7 mm. long, 1.5–3.5 mm. broad, spreading; fruit sausage-shaped with fibrous

chartaceous wall, ca. 5 mm. long, completely enveloped by the tube of the persistent corolla and by the ensheathing calyx-tube and falling away enclosed by them.

Headwaters of the Rio Branco in northern Brazil and adjacent southern British Guiana; northern Venezuela and Colombia and southward along the Andes and northward in Central America and the West Indies.

British Guiana: north side of Kanuku Mts., ca. 10 miles east of the Takutu River, ca. 135 m. alt., small tree, 4.5 m. tall, trunk ca. 8 cm. thick, in secondary forest near edge of savanna, fl. pure white, Oct. 10, 1931, *Forest Dept. Brit. Guiana D230/2221* (K); Pirara (Marakanata), Rupununi Savannas, ca. 120 m. alt., tree ca. 20 m. tall, trunk 11 m. to fork, 4 dm. thick, in sandy soil on patch of savanna-forest on top of ridge, Oct. 21, 1931, *Forest Dept. Brit. Guiana D195/2186* (K).

Brazil: Mniam, tributary of Suruma River, Nov. 1909, *Ule 8290* (K, BD, Del); Limão, lower Cotinga River, Sept. 1927, *Tate 140* (NY).

Although previously I have cited one of the above collections as *C. trichotoma,* Contr. Gray Herb. **92**: 15 (1930), I am now of the opinion that all the material from the upper Rio Branco watershed is more closely related to *C. alliodora.* The corolla-lobes in our plants are 3–3.5 mm. broad. The stems are simply tunneled by ants. There are no distorted, gall-like thickenings in the axis of the inflorescence. Compared with large series of *C. trichotoma* and *C. alliodora* our plants seem most like the latter species in gross aspect. The colony on the Rio Branco was probably derived from northern Venezuela where only *C. alliodora* is known. Strangely *C. alliodora* seems to be rare or absent in the Orinoco Valley and in the other parts of the wet tropical forests of northeastern South America.

Previously I have attempted to maintain the Argentine, Paraguayan and Brazilian plant, ranging to the east and south of the Amazon Basin, as a species distinct from *C. alliodora.* I am now of the belief that this plant, called *C. trichotoma* in my treatment of the Brazilian species, is distinguished from *C. alliodora* only by its larger flowers, and that it had best be classified as a variety of that latter species. The correct trinomial for the large-flowered Brazilian form is *Cordia alliodora* var. *tomentosa* A. DC.

2. **Cordia sebestena** Linnaeus, Sp. Pl. 190 (1753). *Cordia speciosa* Salisbury, Prodr. 111 (1796); DeCandolle, Prodr. **9**: 476 (1845); Pulle, Enum. Pl. Surinam 397 (1906).

Tree or shrub 1–7 m. tall; branchlets with a fine soft curly pubescence and scattered much coarser appressed hairs; leaves ovate to elliptic or subcordate, 9–16 cm. long, 5–14 cm. broad, broadest below the middle, base obtuse or rounded or subcordate, apex obtuse to coarsely

short-acuminate, margin entire, upper surface with scattered short stiff appressed hairs, the hairs usually arising from minute pustulate disks, lower surface glabrescent or sparsely strigose, with 5–6 pairs of veins; petiole slender, 1–4 cm. long; inflorescence corymbose, usually terminal, ascendingly branched; calyx firm, strigose and densely brown puberulent, elongate in the bud, 12–15 mm. long, 3–5 mm. thick, opening by several unequal teeth ca. 2–3 mm. long, at maturity becoming much expanded by the enlarging fruit which it encloses, 3–4 cm. long; corolla orange or scarlet, funnelform, tube twice length of the cylindrical calyx; fruit bony, dry, ovoid, pointed, 1–2 cm. long, completely and tightly invested by the juicy white accrescent calyx.

Native on the islands of the Caribbean and probably also along the coasts of Venezuela, Colombia and Central America; frequently cultivated in the Tropics.

BRITISH GUIANA: Botanic Gardens, Georgetown, cultivated, Aug. 1905, *collector not given 7976/6915* (BD).

DUTCH GUIANA: Surinam, cultivated, tree 6–9 m., fl. red, Dec. 1837, *Splitgerber 312* (Leid); Cottica district near Plant. Alliance, Aug. 1901, *Went 280* (Utr); Paramaribo, *Focke 1371* (Utr).

FRENCH GUIANA: indefinite, 1802, *Gabriel* (Del).

3. **Cordia fallax,** sp. nov. *Cordia guianensis* Klotzsch ex Schomburgk, Fauna u. Fl. Brit. Guian. 960 (1848), nomen; not *C. gujanensis* (Desv.) R. & S. (1819), nor *C. guianensis* R. & S. ex DC. (1845).

Arbor 5–10 m. alta; ramulis brunnescentibus cum pilis abundantibus brevibus erectis velutinis; foliis homomorphis ellipticis vel obovato-oblongis 15–40 cm. longis 6–18 cm. latis ad medium vel paullo supra medium latioribus minute glanduloso-punctulatis, basi rotundis vel subcordatis ad obtusis vel late acutis, apice breviter acuminatis, margine integerrimis vel rariter leviter sinuatis, supra lucentibus in costa et nervis primariis pilos inconspicuos gerentibus ceteris glabris vel subglabris, subtus pilis plus minusve abundantibus gracillimis ascendentibus molliter vestitis, nervis 7–8-jugatis, costa falcato-curvatis, petiolis 15–30 mm. longis; cymis ramulos foliatos terminantibus laxissime ramosis ad 3 dm. diametro; calyce in alabastro obovoideo extus indumento brunnescente velutino molli vestito, intus glaberrimo, ad anthesin ca. 5 mm. longo (lobis deltoideis 5), fructifero explanato 10–14 mm. lato; corolla 1 cm. longa, lobis obovatis extus glabris, filamentis basim versus pilosis; ovario et stylo glaberrimo; fructu glabro; nuce valde rugoso oblique ovoideo acuminato ca. 18 mm. longo.

Endemic to British Guiana.

BRITISH GUIANA: Issorora, Aruka River, wet forest, tree 9 m. tall, Jan.

1920, *Hitchcock 17563* (TYPE, Gray Herb.; isotype, NY); upper Rupununi River near Dadanawa, ca. lat. 2° 45′ N., tree 5 m. tall, June 10, 1922, *La Cruz 1484* (NY); indefinite, 1844, *Schomburgk 875/1510b* (K); indefinite, 1841, *Schomburgk 875* (BD, Del, P); indefinite, *Schomburgk 1510* (BD, TYPE of *C. guianensis;* G).

Although bearing various numbers and different data, the material from Schomburgk cited above agrees so completely in details of maturity, pressing, etc., that one may recognize it as consisting of parts of a single collection. The material at Berlin bears Klotzsch's binomial. This, however, has never been associated with a description and is further invalid by reason of being a homonym. Schomburgk, l. c., reported *C. guianensis* Kl. only from the banks of the Barama River and there is every reason for believing that this is indeed the source of the Schomburgk material mentioned.

The species has been confused with *C. tetrandra,* although it is readily distinguished from that species by having glabrous upper leaf-surfaces and in being noticeably larger in all its parts. Its relations are with that group of species of Venezuela and Colombia which is exemplified by *C. bogotensis* Benth. Its very large leaves, hairy beneath, quickly distinguish it from these much more westerly species.

4. **Cordia tetrandra** Aublet, Hist. Pl. Guian. Fr. **1**: 222, tab. 87 (1775); Poiret, Encyc. **7**: 42 (1806); Pulle, Enum. Pl. Surinam 397 (1906); Johnston, Contr. Gray Herb. **92**: 55 (1930). *Lithocardium tetrandrum* (Aubl.) Kuntze, Rev. Gen. **2**: 976 (1891). *Cordia cordifolia* Humboldt, Bonpland & Kunth, Nov. Gen. et Sp. **3**: 70 (1818); DeCandolle, Prodr. **9**: 483 (1845). *Lithocardium cordifolium* (HBK.) Kuntze, Rev. Gen. **2**: 976 (1891). *Cordia muneco* Humboldt, Bonpland & Kunth, Nov. Gen. et Sp. **7**: 207 (1825); DeCandolle, Prodr. **9**: 486 (1845). *Lithocardium muneco* (HBK.) Kuntze, Rev. Gen. **2**: 977 (1891). *Borellia asper* Rafinesque, Sylva Tellur. 41 (1838). *Cordia umbraculifera* DeCandolle, Prodr. **9**: 484 (1845); Schomburgk, Fauna u. Fl. Brit. Guian. 960 (1848); Fresenius in Martius, Fl. Bras. **8**[1]: 16 (1857). *Lithocardium umbraculiferum* (DC.) Kuntze, Rev. Gen. **2**: 977 (1891).

Tree, 3–12 m. tall; branchlets pallid, tomentose with abundant curved spreading short hairs; leaves homomorphic, ovate to elliptic or oblong or lance-ovate, broadest either below or just above the middle (usually the latter), 1–1.7 dm. long, 5–14 cm. broad, base more or less oblique, obtuse or rounded or subcordate, apex obtusish to acute, the very tip blunted (not acuminate), under surface green, sparsely strigose, secondary venation obscure, lower surface much paler, more or less brownish with rather abundant short slender curved hairs which spring from

the much rebranched veins, usually velvety, with 7–10 pairs of veins; petioles well developed, 2–5 cm. long; cymes usually terminating leafy branchlets, loosely branched, 1–3 dm. broad; calyx obovoid in bud, densely covered with fine appressed hairs, inside sparsely strigose or hispidulous; calyx at anthesis 2.5–3.5 mm. long, with 4–5 more or less equal deltoid lobes, in fruit explanate and 5–7 mm. broad; corolla white, prevailingly 5-merous, 4–5 mm. long, glabrous, lobes elongate, filaments exserted, hairy at base; ovary and style glabrous; fruit glabrous; stone very rugose, transversely compressed-ovoid, ca. 1 cm. long, pulp white and mucilaginous.

Northeastern coast of Brazil (Maranhão and Pará), northern South America and southward along the Andes to Bolivia; frequently cultivated.

BRITISH GUIANA: Rockstone, banks of the Essequibo, 1921, *Gleason 865* (K); Demerara River, May 1889, *Jenman 4878* (K); Demerara, *Parker* (K, DC); Platburg Creek, Canje River, fruit glutinous, yellowish green, 1914, *Hohenkerk 631* (K); indefinite, large tree, flowers yellowish white, 1837, *Schomburgk 408* (DC, TYPE of *C. umbraculifera;* isotypes, G, K, BD, P).

DUTCH GUIANA: upper Nickerie River, Feb. 1915, *B. W. 1074* (Utr); near Paramaribo, 1910, *native collector* (Utr); near Paramaribo, tree, fl. white, 1844, *Kappler, ed. Hohenacker 1619* (Utr, P); Plant. Jagtlust, 5 m. tall, 1913, *Soeprato 6E* (Utr); Plant. Osembo-Onverwacht, 1913, *B. W. 6229* (Utr); Plant. Slootwijk, tree 5 m. tall, *Soeprato 10H* (Utr); Watramiri, tree no. 1568, fruit edible, mucilaginous, June 4, 1916, *B. W. 1836* (Utr); Watramiri, tree no. 1568, Feb. 7, 1917, *B. W. 2659* (Utr); Watramiri, tree no. 1568, Feb. 18, 1920, *B. W. 4551* (Utr); Watramiri, tree no. 1568, Dec. 7, 1920, *B. W. 4974* (Utr); Surinam, tree 9–12 m. tall with broad horizontal branches, usually cultivated, fl. white, Nov. 1837, *Splitgerber 123* (Leid); Surinam, 1841, *Berthoud-Coulon 553* (BM); Surinam, *Hostmann 355* (K, BM, BD, Del, P); Surinam, *Hostmann* (Utr).

FRENCH GUIANA: Mana, March 1854, *Mélinon 215* (P); Mana, 1857, *Sagot* (P); Iles du Salut, fruit white, glutinous, 1854, *Sagot 445* (K, BM, P); Ile de Cayenne, 1851, *Sagot* (P); Cayenne, *Aublet* (BM, TYPE of *C. tetrandra*); Mahoury near Cayenne, *Sagot* (P); indefinite, *Martin ex herb. Rudge* (BM), *LePrieur 252* (Del, P), *Perrottet* (P), *Gabriel* (Del) and *Poiteau* (K).

Aublet reports *C. tetrandra* from the Ile de Cayenne and from the mainland of French Guiana. I have examined specimens from his personal herbarium, now at the British Museum, as well as a duplicate from it now in the Swartz herbarium at Stockholm. His description, his illustration, and the two specimens, leave no doubt as to the exact identity of *C. tetrandra*. Aublet's name is inapt, the species is practically always pentandrous.

The species appears to be indigeneous only in a broad band of wet tropical forest about the northern margin of South America, where it seems to be most common at low altitudes on the coastal plain. On the east base of the Andes it is known from Peru and Bolivia. I have seen no material from the dryer portions of Brazil to the south of the Amazon Basin that is indubitably from wild plants. Brade, Bol. Mus. Nac. Rio Janeiro 8: 35 (1932), however, has recently reported it from Manáos. The collections by Spruce from the mouth of the Rio Negro, reported (sub *C. umbraculifera*) in the Flora Brasiliensis, 8^1: 16 (1857), is not *C. tetrandra,* but the material subsequently made the type of *C. Sprucei* Mez. I have reported, Contr. Gray Herb. **92**: 55 (1930), *C. tetrandra* from Ceará and Pernambuco. This was incorrect and is the result of a bad clerical error. The specimens actually represent *C. toqueve.* I am indebted to Mr. Killip, *in lit.,* and to Mr. Brade, l. c. 34, for the correction of this unfortunate error.

The wood of *C. tetrandra* has been described by Pfeiffer, De Houtsoort. v. Surinam. 1: 444 (1926). In the herbarium at Utrecht the collection, cited above, from the Plantation of Osembo-Onverwacht bears the annotation, "Pfeiffers Woods of Surinam no. 59."

Aublet states that the species is called "Bois Margarite" and "Arbre à parasol." The following vernacular names are associated with the specimens cited above, Kakuru or Clammy Cherry—*Hohenkerk 631;* Kakhoro' (Arow.), Tafrabom (Nig. Eng.) and Alatoeloeka (Kar.)—*B. W. 1074;* Tafelboom—*B. W. 6229* and *Splitgerber 123;* Tafelboom (Sur. Dutch), Tafraboom (Nig. Eng.), Boggi lobbi (Saram.), Toenbalobbi (Saram.), Kakhoro (Arow.), Araatroekoe (Kar.)—*Watramiri tree no. 1568;* Bois parasol—*Sagot 445;* Roqueí—*Sagot at Cayenne and Mahoury.*

5. **Cordia nodosa** Lamarck, Tab. Encyc. 1: 422 (1791); Poiret, Encyc. 7: 43 (1806); Schomburgk, Fauna u. Fl. Brit. Guian. 960 1848); Fresenius in Martius, Fl. Bras. 8^1: 16, tab. 5 (1857); Bailey, Bot. Gaz. **77**: 32–49, tab. 6–7 (1924); Johnston, Contr. Gray Herb. **92**: 46 (1930). *Lithocardium nodosum* (Lam.) Kuntze, Rev. Gen. 2: 977 (1891). *Cordia hirsuta* Willdenow, Sp. Pl. 1: 1076 (1798); Meyer, Prim. Fl. Esseq. 114 (1818). *Firensia hirsuta* (Willd.) Rafinesque, Sylva Tellur. 40 (1838). *Cordia formicarum* Hoffmannsegg ex Roemer & Schultes, Syst. 4: 800 (1819). *Cordia miranda* DeCandolle, Prodr. 9: 475 (1845). *Lithocardium mirandum* (DC.) Kuntze, Rev. Gen. 2: 977 (1891). *Cordia hispidissima* DeCandolle, Prodr. 9: 475 (1845). *Lithocardium hispidissimum* (DC.) Kuntze, Rev. Gen. 2: 977 (1891). *Cordia nodosa* var. *hispidissima* (DC.) Fresenius in

Martius, Fl. Bras. 8^1: 17 (1857). *Cordia nodosa* var. *angustifolia* Fresenius in Martius, Fl. Bras. 8^1: 17 (1857). *Cordia umbrosa* Spruce ex Rusby, Bull. Torr. Bot. Cl. **26**: 147 (1899). *Cordia volubilis* Pittier, (Explor. Bot. Cuenca de Maracaibo p. 41) Bol. Comer. e Indust. **4**: ? (1923); Jour. Wash. Acad. Sci. **19**: 184 (1929). *Cordia collococa* sensu Aublet, Hist. Pl. Guian. Fr. **1**: 219, tab. 86 (1775).

Shrub or tree, 2–11 m. tall; stems bearing stiff spreading brownish bristles which are usually abundant but may be sparse or nearly absent; the stems below each fork abruptly and asymmetrically enlarged and containing a cavity usually serving as an ant-domatium; leaves usually subopposite or whorled, more or less heteromorphic, somewhat lustrous on both surfaces, lanceolate to nearly elliptic, broadest near the middle, 10–35 cm. long, 3–28 cm. broad, base obtuse, apex acuminate, margin entire, upper surface with impressed veins, more or less bullate, with a few hairs along the midrib, lower surface paler, with very scattered bristles on the veins, with 6–10 pairs of veins, these repeatedly rebranched and anastomosing, petiole 2–5 mm. long, bristly; inflorescence cymose-paniculate, loose or dense, 2–10 cm. in diameter, bristly and usually also with minute curly brownish pubescence, borne at the forks of the stem; calyx usually somewhat puberulent and strigose, more or less bristly especially about the apiculate apex, papery in texture and very obscurely ribbed, opening irregularly to form several very irregular lobes, frequently persisting and eventually breaking up into fibers; calyx in the bud ovoid or ellipsoid, ca. 5 mm. long; corolla white, tube 4–6 mm. long, lobes 2–3 mm. long, filaments hairy at base, 3–4 mm. long; style and ovary hairy; fruit usually more or less bristly; stone transversely ovoid, 13–17 mm. long.

In British, Dutch and French Guiana and widely distributed in the Amazon Basin; also in the headwaters of the Orinoco (in southern Venezuela and eastern Colombia) and in northwestern Venezuela.

BRITISH GUIANA: Amakura River, 5 m. tall, March 1923, *La Cruz 3430* (G); Barima River, March 1896, *Jenman 7055* (K); Kamakusa, upper Mazaruni, ca. long. 59° 50′, 1922–23, *La Cruz 2887* and *4231* (G); Macouria River, Nov. 1886, *Jenman 2391* and *2392* (K); Tumatumari, dense upland forest, shrub 2.5–6 m. tall, 1921, *Gleason 311* (K); Kaieteur Falls, Potaro River, 1923, *La Cruz 4407* (G); island in Cuyuni River below Kamaria Falls, 18 dm. tall, 1920, *Bailey 40* (G); Kartabo region, second growth forests, 1920, *Bailey 29, 41* and *42* (G); Bonasika Creek, at sea-level, *Anderson 66* (K); Moraballi Creek, small tree up to 6 m. tall, in low brush and clearings in mixed forest, fl. white, fruit bristly, becoming pale red, Aug. 15, 1929, *Sandwith 12* (K, BD); Rockstone, dense upland forest, 2.5–3 m. tall, 1921, *Gleason 583* (K); Blue Mts., Demerara, fruit red, hairy, sweet and clammy, an expectorant, *Parker 272* (K); Demerara

River, May 1889, *Jenman 4924* (K); Malaroo Creek, Corantyne River, small tree, 3–6 m. tall, Oct. 1879, *im Thurn* (K, P); indefinite, *Schomburgk 904* (K) and *984* (K, BM, BD, P).

Dutch Guiana: Kaboeri Reserve, Corantyne River, tree no. 684, Nov. 1920 and Aug. 1922, *B. W. 4835* and *5986* (Utr); mouth of Lucie River, Corantyne River, 1910, *Hulk 315* (Utr); way to Kwatta, Paramaribo, June 1916, *Samuels 237* (G, Leid, BD, P); Station at Groningen, forest, May 1916, *Samuels 123* (G, K, Leid, BD, P); Watramiri reserve, Saramacca River, June 1918, *B. W. 3864* (Utr); Watramiri reserve, tree no. 1652, mature fruit yellow, soft and sweet, Dec. 1916, *B. W. 2488* (Utr); Watramiri, tree no. 1652, used for tea, May, 1916, *B. W. 1911* (Utr); Watramiri reserve, tree no. 1652, April 1917, Oct. 1917, July 1918, and Feb. 1920, *B. W. nos. 2756, 3309, 3872* and *4541* (Utr); Watramiri reserve, tree no. 1652, fl. white, *B. W. 4012* (Utr); Watramiri reserve, tree no. 1652, March 1919, ripe fruit sordid white, *B. W. 4301* (Utr); Sectie O. reserve, upper Para River, tree no. 800, fl. light green, leaves used for tea, Aug. 1916, *B. W. 2306* (Utr); woods near Poelebantji, tree 4–6 m. tall, Feb. 1845, *Kegel 691* (Utr); Brownsberg, Surinam River, tree 10 m. tall, trunk 1 dm. thick, fl. sordid white, Sept. 1915, *B. W. 727* (Utr); Brownsberg reserve, tree no. 1174, fl. white, dried leaves used as a substitute for tea, fruit yellow, globose, soft and juicy, Nov. 1916, *B. W. 2498* (Utr); Brownsberg reserve, tree no. 1174, fl. white, Sept. 1918, *B. W. 4002* (Utr); Brownsberg reserve, tree no. 1174, March 1917, Feb. 1919 and March 1921, *B. W. nos. 2721, 4265* and *5075* (Utr); Brownsberg reserve, tree no. 1174, fl. sordid white, with strong odor, Sept. 1923, *B. W. 6227* (Utr); Brownsberg reserve, tree no. 1174, fl. sordid white, odor strong, Nov. 1924, *B. W. 6684* (Utr); Brownsberg summit, July 1924, fl. white, *B. W. nos. 6634* and *6722* (Utr); woods near Raleigh Falls, Coppename River, hispid tree, fl. yellowish white, fruit white, hispid, Sept. 11, 1933, *Lanjouw 788* (Utr).

French Guiana: Maroni, 1864, *Mélinon* (G, Del, P); Ile Portal, Maroni River, *Sagot* (P); Ile Portal, fruit white, soft, size of a grape, June 1857, *Sagot 446* (P); Acarouani, tree, corolla pale yellowish, sepals 4, stamens 4, Oct. 1854, *Sagot 446* (P); Acarouani, 1854, *Sagot* (P); Acarouani, fruit red, April 1858, *Sagot 446* (P); Acarouani, 1859, *Sagot* (P); Acarouani, fruit pale yellow, 1854, *Sagot 446* (P); Godebert, *Wachenheim 410* (P); in loco Macaya ad praedicem Patuis, *Richard* (P) vicinity of Cayenne, hill above Grant's Road, Montabo, shrub, 1921, *Broadway 543* (G, K); Cayenne, *Martin* (BM, BD, P); Cayenne, March 1859, *Sagot* (P); Cayenne, *Patris* (BM, Del); indefinite, 1850, *Leprieur* (BM, P); indefinite, *Aublet* (BM, type of *C. nodosa*); indefinite, *Perrottet 214* (Del, DC) and *Poiteau* (K, BD, P).

Brazil: Carmo, Rio Branco, Sept. 1, 1924, *Bequaert* (G); Surumu, Serra do Mairary, Rio Branco, tree or shrub 2–8 m. tall, fl. white, Nov. 1909, *Ule 8456* (K, BD); Rio Negro below mouth of Xibarú, betw. Barcellos and São Gabriel, Dec. 1854 *Spruce 3790* (NY, K, Del); Rio Cuminá, *Sampaio 5136* and *5148* (BD); near Montalegre, Nov. 24, 1873, *Traill 561* (K); Prainha, Dec. 17, 1873, *Traill 562* (K).

VENEZUELA: Casiquiari, in shade along streams, fl. white; tree 6 m. tall, Jan. 1853, *Spruce 3281* (G).

This is a classic ant-plant. The results of an anatomical study and a review of the more important literature on this plant have been published recently by I. W. Bailey, Bot. Gaz. **77**: 32–49, tab. 6–7 (1924). According to this author the peculiar subnodal structures serving as ant-domatia are "formed by an invagination of epidermal, cortical, and fibrovascular tissues which originate in the axil of one of the leaves of the false verticil, and which develops into the interior of a more or less symmetrical or unilateral, subnodal enlargement of the cauline axis."

The attention drawn by the complex ant-domatia has, I believe, blinded students to the evident relationships of this remarkable plant. The flowers and fruit are very similar to those found in *C. Sprucei* and its relatives. The apiculate, papery, irregularly disrupted calyx, the hairy ovary and style, and the transversely ovoid stone, not to mention the glabrous upper leaf-surfaces, comparatively stiff and contracted inflorescence, etc., all indicate close relations with that group of upper Amazon and Guianan species. *Cordia nodosa* has only three notable peculiarities, its subnodal swellings, its bristly indument, and its fibrous calyx. In the past the species has been placed in a special section, *Physoclada*, of the genus *Cordia*. I have become so impressed with its obvious relations with *C. Sprucei* and allies, however, that I now am quite content to associate it with these species in the section *Pilicordia*.

The species is very variable both in the size and shape of its leaves, and in the abundance of the bristles on its herbage. This variation seems to be ecological in origin. In any case I can find no evidence that it is in any way geographically correlated. It should be noted that collectors have given the fruit in British Guiana as red. In Dutch and French Guiana the fruit is given as white or whitish in numerous cases, and once as yellow.

Aublet gives the Carib name for the plant as "Achira-mourou." The following vernacular names are associated with specimens cited: Courabelli ants plant—*Anderson 66;* Ylūrĭ-hee-lĕvĭ-koŭ—*Parker 272;* Hurneyreyroko—*Sandwith 12;* Awelemoeloe (Kar.)—*B. W. 727;* Marribonsoehoedoe (Neg. Eng.), Horowejoreroko (Arow.), Arreuonoe (Kar.)—*Tree no. 1652 at Watramiri;* Mattoe toenbalobbi (Sar.), Horowé, joee lokko, Hoereuereroko (Arow.), and Awali emoeloe, Aloeko uonoré (Kar.)—*Tree 800 at Sectie O.*

6. **Cordia laevifrons,** sp. nov.

Arbor minor vel frutex, dichotome ramosus; ramulis fuscis, apicem versus dense puberulis mox glabrescentibus; foliis vix crassis ellipticis

ad lanceolato-oblongis vel oblongo-obovatis 12–25 cm. longis 6–14 cm. latis saepe ad medium vel supra medium latioribus, basi obtusis vel plus minusve rotundis vel late acutis, apice saepe abrupte acuminatis, supra lucentibus saepe in costa pilos paucos adpressos gerentibus ceteris glaberrimis, subtus pallidioribus glabris vel sparsissime minutissimeque ascendenter adpresseque pubescentibus, nervis primariis 6–8-jugatis, nervis tertiariis obscuris, petiolis 5–18 mm. longis; cymis saepissime in furcis ramulorum ortis, laxe graciliterque ramosis 3–15 cm. diametro, pedunculo gracili; corolla alba glabra, tubo 6 mm. longo calycem superante, lobis 2 mm. longis rotundis latis, filamentis 4 mm. longis longe exsertis basim versus pilosis; calyce in alabastro anguste obovato 4–5 mm. longo extus dense puberulento (intus subglabro) obscure lateque 10-costato, apice plus minusve apiculato ad anthesin in lobos irregulares lacerulatos disrupto, fructifero explanato; stylo et apice ovarii sparse minuteque hispidulo; fructu glaberrimo; nuce transverse ovoideo 10–14 mm. longo.

Endemic to French and Dutch Guiana.

Dutch Guiana: Lucie River, a small tree 6 m. tall, fl. white, April 12, 1926, *B. W. 6999* (Utr); forest near Abontjeman, May 1910, *native collector 236* (type, Utrecht).

French Guiana: Maroni River, 130 km. upstream, fruit edible, 1877, *Crevaux* (P); along the Maroni, 1861, *Mélinon 16, 59, 254* and *271* (P); along the Maroni, 1863, *Mélinon 283* (P); Maroni, along road to St. Laurent, clearings, 15 dm. tall, fl. white, Oct. 1876, *Mélinon 225* (P); St. Jean, 2 m. tall, fl. white, May 16, 1914, *Benoist 1230* (P).

A relative of *C. Sprucei* notable chiefly for its rather thin, nearly glabrous leaves, puberulent obscurely ribbed calyces, and quite glabrous fruits. As with other relatives of *C. Sprucei* the veins of the leaves are not so finely rebranched as is common in this section of the genus. Crevaux gives the bush-negro name of the plant as "Tiki Topichi."

7. **Cordia Sprucei** Mez, Bot. Jahrb. **12**: 549 (1890); Johnston, Contr. Gray Herb. **92**: 53 (1930). *Lithocardium Sprucei* (Mez) Kuntze, Rev. Gen. **2**: 977 (1891).

Tree 4–5 m. tall, branching dichotomous; branchlets dark, sparsely short-hirsute or with short incurved hairs; leaves drying brown, subhomomorphic, elliptic or oblong-obovate, 12–23 cm. long, 6–11.5 cm. broad, broadest at or above the middle, apex acuminate, base acute to truncate, upper surface somewhat lustrous, hairy along the midrib and with scattered hairs along the principal veins but otherwise glabrous, lower surface with rather abundant short soft erect hairs, petiole 5–10 mm. long, veins in 6–9 pairs, tertiary veins tending to be obscure; in-

florescence rather loosely though rigidly branched, ca. 1 dm. thick, usually borne at the forks of the stem, rarely terminal; calyx well covered with short incurving tawny hairs, obscurely ribbed, obovate in the bud and apiculate, 4–5 mm. long, ca. 2.5 mm. thick, bursting rather irregularly at the apex into 2–5 broad rather thin teeth; corolla white, tube 4–5 mm. long, lobes broad ca. 1.5 mm. long, filaments hairy at base, 4 mm. long; ovary densely hairy above the middle; fruit yellow, strigose; stone transversely ellipsoid, 1–1.5 cm. long.

Known only from the Rio Negro of Brazil and from French Guiana.

FRENCH GUIANA: "in Sylvis doeciduis Fluvii Kourou, ad casam indi Felix," Nov., *Richard* (P).

BRAZIL: Barra do Rio Negro, 1850–51, *Spruce 1019* (Munich, TYPE; BD, frag; G, photo.); vicinity of Barra, 1850–51, *Spruce* (G, K, BM); Barra to Matiriho, Jan. 1851, *Spruce 1234* (K, BM); Barra, fruit yellow, transversely oblong, April 1851, *Spruce 1234* (K, BM, Del); São Gabriel, Rio Negro, ca. 90 m. alt., 1930–31, *Holt & Blake 608* (G).

Richard's label gives the following field data concerning his collection from French Guiana,—"frutex 3–4 ped., ramis diffuse patentibus, dichotomis; fl. albidi; ramillis cymae recurvis et, inexpansis floribus, revolutis." The collections are remarkably similar to Spruce's material from the lower Rio Negro, except that in one of Richard's two sheets the branches of the inflorescence are somewhat tawny tomentulose.

Since discussing the type of *C. Sprucei*, l. c., I have examined the actual type-specimen at Munich. The specimen has the following familiar printed label reading, "In vicinibus Barra, Prov. Rio Negro, coll. R. Spruce, Dec.-March, 1850–51." The collector's number, in script, is "1019." The specimen is that cited under *C. umbraculifera* in the Flora Brasiliensis. It is evidently part of the same collection as the unnumbered specimens I have seen at the Gray Herbarium, at Kew, and at the British Museum.

This species not only has relatives in *C. nervosa* and *C. laevifrons* of the Guianas but also in undescribed trees of the Putumayo and the Huallaga of eastern Peru. The glabrous upper leaf-surfaces and the somewhat papery irregularly disrupted apiculate calyces are characters of this group of species.

8. **Cordia nervosa** Lamarck, Tab. Encyc. **1**: 422 (1791); Poiret, Encyc. **7**: 47 (1806); DeCandolle, Prodr. **9**: 484 (1845). *Lithocardium nervosum* (Lam.) Kuntze, Rev. Gen. **2**: 977 (1891). *Cordia calophylla* Vahl, Ecolog. **3**: 5 (1807); DeCandolle, Prodr. **9**: 486 (1845). *Lithocardium calophyllum* (Vahl) Kuntze, Rev. Gen. **2**: 976 (1891).

Shrub or small tree, up to 5 m. tall; branchlets closely and antrorsely strigose; leaves homomorphic, stiff and coriaceous, with an arcuate mid-

rib, broadly lanceolate to elliptic or lance-oblong, 10–25 cm. long, 4–10 cm. broad, margin weakly recurved, apex acuminate, base rounded to acute and usually more or less oblique and asymmetrical, upper surface glossy, smooth and quite glabrous, lower surface drying brown, dull, somewhat scabrous with abundant short inconspicuous hairs, with 8–10 pairs of primary veins, these connected by simple branches, the secondary branches of the veins absent or very obscure; petiole canaliculate, stiff, 5–10 mm. long; inflorescence small and compact, 1–4 cm. long, peduncles very short or none, branches slender, strictly forked, bearing flowers on only one side and in age studded with the elevated pedicellar flower-attachments, becoming rigid and woody in age and more or less spreading or deflexed, persistent long after the falling of the fruit; calyx obovoid in bud, 4–5 mm. long, minutely short-strigose, more or less apiculate, not at all ribbed, sparsely strigose inside, bursting apically and the lobes torn and irregular, in fruit explanate; corolla white, tube ca. 5 mm. long, lobes broad, ca. 3 mm. long, filaments very hairy; ovary glabrous or sparsely hairy towards the apex; style usually sparsely hairy; fruit minutely and abundantly strigose, pulp bright red, glutinous, insipid; stone transversely ovoid, 10–13 mm. long.

French Guiana and adjacent Brazil; British Guiana.

British Guiana: Kaieteur Savanna, spreading shrub 18 dm. tall, 1881, *Jenman 1062* (K).

French Guiana: Cayenne, 1857, *Mélinon* (P); Gourdonville, Kourou River, shrub, fl. white, Sept. 25, 1914, *Benoist 1618* (P); in umbrosis sylvis praedii Dm. [?] Patuis, *Richard* (P); indefinite, *herb. Lamarck* (Paris, type of *C. nervosa*); indefinite, *von Rohr 152* (herb. Vahl, type of *C. calophylla;* BM, isotype); indefinite, 1859, *Leprieur* (Del); indefinite, 1819–21, *Poiteau* (K, Del).

Brazil: Counany, Oct. 13, 1895, "Chapeo del Sol," *Huber 1032* (Boiss).

The type of *C. nervosa* in the Lamarck herbarium is so very similar to the material collected by Richard (in the General Herbarium at Paris) that I believe they are parts of a single collection or, in other words, that the type of *C. nervosa* was collected by Richard. Unfortunately, I have been unable to identify Richard's locality with any degree of confidence. At Paris I found on the label of a very different species the following more explicit mention of the probable locality, i. e. "in loco Dm. [spelling?] Macaya ad praedicem Dm. [?] Patuis." There was formerly a sugar plantation called Macaya on the Ile de Cayenne several kilometers east of Matoury. This may have been that referred to by Richard, for he is known to have collected extensively about the Island of Cayenne as well as over most of the French Guianan coastal region.

It is interesting to note that Richard has appended to his specimen a manuscript name, under *Collococcus*, in which the same specific epithet is used as was subsequently published by Vahl. Richard and von Rohr were both in the Guianas about 1785. These facts naturally make one wonder if there may not have been some meeting or some exchange of material between these two botanists and possibly if Vahl's type may not have had the same source as that of Lamarck.

The species is an unusually distinct one, being notable because of its suppressed tertiary leaf-veins and small dense subsessile inflorescence. Its closest relations are with *C. Sprucei* and *C. laevifrons* which have similar somewhat papery, irregularly dehiscent apiculate calyces. In *C. Sprucei* the veins are more repeatedly branched than in *C. nervosa*, though generally less so than in other species of the section *Pilicordia*.

9. **Cordia fulva**, sp. nov.

Arbor vel frutex, dichotome ramosus; ramulis brunneis cum pilis brevibus divergentibus abundantissimis velutinis; foliis subhomomorphis crassiusculis ellipticis vel ovatis 10–22 cm. longis 7–11 cm. latis saepe ad medium vel supra medium latioribus, basi obtusis vel rotundis vel rariter acutis, apice breviter acuminatis, supra scabris pilis brevibus rigidusculis ascendentibus vestitis, subtus saepe brunnescentibus velutinis in nervis et nervulis elevatis et numerosis pilos graciles erectos abundantes gerentibus, nervis 5–7-jugatis, petiolis brevibus; cymis in furcis ramulorum ortis vel rariter terminalibus, rigidis brunneo-velutinis laxe ramosis, floribus in ramulis plus minusve congestis; calyce in alabastro obovato 4–5 mm. longo 2–3 mm. crasso evidenter 10-costato extus brunneo-velutino intus supra medium strigoso; lobis 5 deltoideis; corolla alba, tubo 5 mm. longo, lobis ca. 2.5 mm. longis et latis, filamentis 4–5 mm. longis basim versus pilosis; ovario apicem versus dense longeque pilosis; fructu evidenter velutino; nuce transverse ovoideo 1–1.5 cm. longo.

Known only from northern Dutch Guiana and adjacent French Guiana.

DUTCH GUIANA: near Abontjeman, in forest, May 1910, *native collector 227* (Utr); near Gold Placers, April 14, 1910, *native collector 103* (Utr).

FRENCH GUIANA: Maroni, shrub 3 m. tall, in clearings, fl. white, branches horizontal, 1877, *Mélinon 137* (TYPE, Gray Herb.; isotype, Paris); Maroni, *Mélinon 455* (G, P); Maroni, *Wachenheim 75* (G, P); indefinite, 1862, *Mélinon 82* (P); indefinite, 1821, *Perrottet* (P).

Related to *C. trichoclada* DC. and *C. Chamissoniana* Don, of eastern Brazil, this species differs from the former in its velvety rather than

bristly stems, more softly hairy scarcely bullate leaves, looser less stiffly branched larger inflorescences and slightly smaller calyces, and from *C. Chamissoniana* in its more hairy leaves and conspicuously ribbed, more tawny calyces.

10. **Cordia toqueve** Aublet, Hist. Pl. Guian. Fr. **1**: 228, tab. 90 (1775); Poiret, Encyc. **7**: 44 (1806); DeCandolle, Prodr. **9**: 488 (1845); Johnston, Contr. Gray Herb. **92**: 52 (1930). *Lithocardium toqueve* (Aubl.) Kuntze, Rev. Gen. **2**: 977 (1891). *Cordia heterophylla* Poiret, Dict. Sci. Nat. **10**: 409 (1818); Willdenow ex Roemer & Schultes, Syst. **4**: 800 (1819); Chamisso, Linnaea **4**: 480 (1829); DeCandolle, Prodr. **9**: 487 (1845). *Lithocardium heterophyllum* (Poir.) Kuntze, Rev. Gen. **2**: 977 (1891). *Cordia pubescens* Willdenow ex Roemer & Schultes, Syst. **4**: 800 (1819). *Lithocardium pubescens* (Willd.) Kuntze, Rev. Gen. **2**: 977 (1891). *Toquera tomentosa* Rafinesque, Sylva Tellur. 40 (1838). *Cordia hebecarpa* DeCandolle, Prodr. **9**: 488 (1845). *Lithocardium hebecarpum* (DC.) Kuntze, Rev. Gen. **2**: 977 (1891).

Tree; branchlets velvety with abundant soft more or less curled brown hairs; leaves strongly dimorphic, upper surface with rather abundant short straight ascending hairs, lower surface velvety with curved soft slender spreading hairs from the prominent and numerous veins and veinlets; larger principal leaves very broadly lanceolate to lance-ovate, broadest towards the base, 1–3 dm. long, 6–15 cm. broad, above the middle contracted to an acute or acuminate apex, base obtuse to rounded, somewhat oblique; smaller sort of leaves more or less orbicular, 5–12 cm. long, 5–11 cm. broad, broadly obtuse or even subcordate at base, rounded or acuminate at apex; inflorescence loosely and slenderly branched, 1–1.5 dm. broad; calyx obovoid in bud, 2.5–3 mm. long, opening by 5 triangular lobes, unribbed, strigose inside, outside covered with a dense indument of appressed slender curved hairs; calyx becoming somewhat cupulate at maturity, ca. 1.5 mm. deep; corolla white, tube 2.5 mm. long, lobes 1.5 mm. long, filaments 2 mm. long, hairy near base; ovary densely hairy at apex; fruit abundantly tawny-strigose, style-base forming a short eccentric beak; stone ovoid, strictly ascending, ca. 1 cm. long.

Confined to French Guiana and eastern Brazil.

French Guiana: vicinity of Cayenne, small tree, fruit yellowish, May 16, 1921, *Broadway 201* (G); near Cayenne, fl. yellow, 1897, *Soubiron* (P); near Cayenne, July 1841, *Mélinon 243* (Leid, P); Cayenne, Feb. 1859, *Sagot* (P); Cayenne, *Martin* (K); Cayenne, *Leblond, ex Mus. Paris 348* (BD, P); Cayenne, *ex Mus. Paris sine no.* (G, BD); Cayenne,

Herb. Willd. sub no. 4574 (BD, TYPE of *C. heterophylla* Willd.); Cayenne, *Herb. Poiret* (P, TYPE of *C. heterophylla* Poir.); indefinite, *Aublet* (BM, TYPE of *C. toqueve*); indefinite, *Poiteau* (K); indefinite, 1859, *Leprieur* (Del).

The original material of this species was collected by Aublet in clearings made by the Caribs about 15 leagues up the Sinnamary River. The tree was called "Toquévé" by these inhabitants of French Guiana. I have seen Aublet's specimen at the British Museum. This material, taken in conjunction with Aublet's illustration and lengthy description, leaves no doubt as to the correctness of the present application of the name.

At Paris among Poiret's specimens (in the Cosson collections) there is a fragmentary specimen of the present species accompanied by a label in Poiret's script reading, *Cordia heterophylla,* folia altera majora et minora, rami asperi, hirti. Caienne. Added to the label in another, and unrecognized hand is "dict. des Sc. nat. herb. Poiret." Poiret stated that *Cordia heterophylla* was seen in the Desfontaines herbarium. The specimen in the Poiret collections at Paris is, I believe, a fragment of the type of *C. heterophylla* Poir., now probably conserved at Florence.

The binomial "*C. heterophylla*" is found on a specimen of *C. toqueve* in Willdenow's herbarium at Berlin and was published by Roemer & Schultes a year after Poiret's published use of the name. The specimen is also given as from "Cayenne" and may be a duplicate of the specimen described by Poiret.

Cordia toqueve is readily distinguished among the South American species by its tawny velvety indument, strikingly dimorphic leaves, and conspicuously hairy fruit. It is known only from Bahia, Ceará and Pernambuco in Brazil, and from near Cayenne in French Guiana. The Brazilian plant, which is quite like that from the Guianas, has been described as *C. hebecarpa* DC.

11. **Cordia scabrifolia** A. DeCandolle, Prodr. **9**: 485 (1845); Johnston, Contr. Gray Herb. **92**: 53 (1930); Brade, Bol. Mus. Nac. Rio Janeiro **8**: 34 (1932).

Tree or shrub up to 15 m. tall, branching dichotomous; branchlets dark, abundantly and minutely antrorse-strigose; leaves homomorphic, ovate- to oblong-lanceolate, 11–18 cm. long, 4–7 cm. broad, broadest near the middle, apex acuminate, base acute to somewhat rounded; upper surface drying dark, abundantly and very minutely antrorse-strigose, lower surface drying light, bearing numerous very minute very short appressed hairs on the abundant veins and veinlets, the hairs tending to be directed centripetally towards the middle of the veinlet-areoles,

petiole 4–9 mm. long, veins in 5–8 pairs, repeatedly rebranched; inflorescence usually borne at the forks of the stems, pedunculate, slender, loosely branched, 4–10 cm. broad; calyx obovoid in the bud, ca. 3 mm. long, densely strigose, opening by 5 subequal triangular lobes, strigose inside, base substipitate; corolla white, tube ca. 3 mm. long, lobes ovate, ca. 2 mm. long, filaments exserted, hairy at base; style and at least the apex of the ovary hairy; fruit densely and minutely strigose; stone ovoid, ascending, ca. 1 cm. long.

Probably restricted to the Amazon Basin; doubtfully reported from British Guiana.

BRITISH GUIANA: indefinite, *Schomburgk 911* (Boiss, TYPE; isotypes, K, BM, BD, P).

BRAZIL: Prainha, Nov. 1873, *Traill 563* (K); Rio Cuminá, Oct.-Nov. 1928, *Sampaio 5367, 5505* and *5510* (BD); Rio Negro-gapó above Cabuquena, Dec. 1851, *Spruce 1942* (K, BM).

Except for the type-collection, *Schomburgk 911*, which is given as from British Guiana, all known collections of *C. scabrifolia* come only from within the Amazon Basin. I suspect that the type also came from the Amazon watershed and from what is now Brazil. Schomburgk, Fauna u. Fl. Brit. Guiana 960 (1848), reports the species from the upper Essequibo. It is significant, however, that no other collectors have found it in British Guiana and that, in the notes of Robert Schomburgk, plant no. 911, which certainly seems to apply to this species, refers to a collection almost certainly from the Rio Negro watershed. In the list no. 911 has no locality indicated but the adjacent numbers, where the locality is indicated in several instances, all do come from Barcellos on the Rio Negro.

12. **Cordia bicolor** A. DeCandolle, Prodr. **9**: 485 (1845); Pulle, Enum. Pl. Surinam 397 (1906). *Lithocardium bicolor* (A. DC.) Kuntze, Rev. Gen. **2**: 976 (1891). *Cordia dichotoma* Klotzsch ex Schomburgk, Fauna u. Fl. Brit. Guiana 1084 (1848), nomen; not Forst. (1797). *Lithocardium Lockartii* Kuntze, Rev. Gen. **2**: 438 (1891). *Cordia Lockartii* Kuntze, Rev. Gen. **2**: 438 (1891), in synonymy. *Cordia trichostyla* Pittier, Contr. U. S. Nat. Herb. **18**: 252, fig. 102 (1920). *Cordia carnosa* Rusby, Three Hundred N. Sp. So. Amer. Pl. 104 (1920). *Cordia coriacea* Killip, Jour. Wash. Acad. Sci. **17**: 329 (1927). *Cordia sericicalyx* sensu Johnston, Contr. Gray Herb. **92**: 54 (1930).

Shrub or small tree up to 6 m. tall, branching dichotomous; branchlets angulate, velvety with very abundant spreading usually tawny short hairs; leaves homomorphic, ovate to more or less broadly lanceolate,

broadest at or below the middle, 8–16 cm. long, 2.5–7 cm. broad, apex acuminate, base acute to rounded, upper surface dark, finely strigose, lower surface very pale, covered by appressed slender hairs that are borne on the veins and veinlets and which converge over and cover the veinlet-areoles; veins in 5–7 pairs, repeatedly rebranched; petiole 5–10 mm. long; inflorescence usually at the forks of the stem, loosely branched; calyx in bud ca. 4 mm. long, obovoid, clothed with abundant short appressed more or less tawny hairs, inner surface with numerous appressed longer white hairs, opening by 5 subequal triangular lobes; corolla white, tube ca. 3 mm. long, lobes ca. 2.5 mm. long, filaments hairy near base; style and upper part of ovary hairy or these exceptionally glabrous; fruit glabrescent; stone transversely ovoid, over 1 cm. long.

Occurring in the Amazon headwaters of Bolivia; east and south of the Amazon Basin in Brazil; and across northern South America from Dutch Guiana to eastern Colombia; apparently very sporadic in occurrence, widely distributed but not common. Also in Central America and in the southern-most West Indies.

BRITISH GUIANA: Oreala, Corantyne River, Oct. 1879, *Jenman 7* (K); indefinite, *Schomburgk "109"* (K); indefinite, *Schomburgk 601* (BM).

DUTCH GUIANA: indefinite, *Hostmann 406* (DC, TYPE of *C. bicolor;* isotypes, K, BD, Del, P); indefinite, *Hostmann & Kappler 406* (Munich); indefinite, *Kappler 406* (P).

BRAZIL: Roraima, 1200 m. alt., corolla white, Feb. 1910, *Ule 8748* (K, BD); Roraima, 1842–43, *Schomburgk 678* (Del, P); indefinite, *Schomburgk 678/1032* (K); indefinite, Nov. 1842, *Schomburgk 1032* (BD, TYPE of *C. dichotoma*).

VENEZUELA: Lower Orinoco, 1896, *Rusby & Squires 418* (NY, TYPE of *C. carnosa*).

In my paper on the Brazilian cordias I quite incorrectly applied the name *C. sericicalyx* to this present species. The type of *C. sericicalyx* is *Schomburgk 109*. There is material of *C. bicolor* at Kew and the British Museum, however, which bears Schomburgk's no. 109. Mr. Killip has suggested to me that this may have resulted from inverting no. 601. Reexamination of the specimens makes me believe this suggestion is correct, especially since one finds in Robert Schomburgk's notes (for nos. 589–700 incl.), which were forwarded from Curasscuraka (on the Rupununi at the base of the Annai Hills) on Feb. 1838, that no. 601 bears the following appropriate data, "a shrub with brown bark growing like the table tree, leaves green, below silvery, calyx light green, petals white, filaments and anthers cream-colored." No locality for no. 601 is given, but it is certain that the gamut of numbers to which

it belongs was collected either during the exploration south to the Akarai Mts., on the Brazilian border, or about the Annai savannas.

Schomburgk's nos. 678 and 1032 appear on printed labels as from "Roraima." Schomburgk approached the base of that mountain from the south (Brazilian territory) along the Kukenam River. It will be noted that Schomburgk, Fauna u. Fl. Brit. Guiana 1084 (1848), reports *C. dichotoma* only from the banks of that Brazilian stream.

13. **Cordia sericicalyx** A. DeCandolle, Prodr. **9**: 485 (1845); Pulle, Enum. Pl. Surinam 397 (1906); not Johnston, Contr. Gray Herb. **92**: 54 (1930). *Lithocardium sericicalyx* (A. DC.) Kuntze, Rev. Gen. **2**: 977 (1891). *Cordia sericicalyx* var. *latifolia* Miquel, Stirp. Surinam. 140 (1850). *Cordia ierensis* Britton, Bull. Torr. Bot. Cl. **50**: 54 (1923).

Tree 3–6 m. tall, branching dichotomous; branchlets slender, finely strigose; leaves conspicuously heteromorphic, firm but rather thin and smooth, much paler beneath, finely strigose on both surfaces, veins repeatedly branched and anastomosing; larger leaves oblong to broadly lanceolate, 11–25 cm. long, 5–12 cm. broad, usually broadest below the middle, base obtuse or broadly acute, midrib somewhat arcuate, veins in 7–11 pairs, petiole densely strigose, 5–20 mm. long; smaller leaves elliptic to orbicular-ovate, 6–8 cm. long, 3–7.5 cm. broad; cymes loose, 5–20 cm. broad, branches slender, usually borne at the forks of the stems; calyx sessile, 5-toothed, outside completely covered with minute appressed silky hairs, inside above the middle densely villous-strigose with the hairs projecting a little beyond the edge of the calyx and so appearing as ciliate margins of the lobes; calyx at anthesis 3–4 mm. long, 1.5–2.5 mm. broad, unribbed, in fruit becoming explanate; corolla ca. 5 mm. long, glabrous, lobes obovate, filaments exserted, pilose near base; ovary and style glabrous; fruit glabrous; stone very rough, depressed, weakly asymmetric 8–10 mm. broad.

Ranging from Dutch Guiana westward to the Orinoco and apparently to Trinidad.

British Guiana: indefinite, *Schomburgk 109* (DC, type of *C. sericicalyx;* isotypes BD, P).

Dutch Guiana: Wayombo River near Cornelis Kondre, tall tree, fl. greenish white, Jan. 23, 1915, *B. W. 824* (Utr); Para District, in forest, Feb.-April, 1844, *Kappler 1510* (Utr, type of var. *latifolia;* isotypes, Leid, BD, Del, P).

Venezuela: lower Orinoco, 1896, *Rusby & Squires 282* (NY, K) and *259* (K).

In my paper on the Brazilian species of *Cordia* I incorrectly applied the name *C. sericicalyx* to the concept properly called *C. bicolor*. Some

of the details of this confusion will be found discussed under *C. bicolor* in the present paper.

The type of *C. sericicalyx* is *Schomburgk 109*, given merely as from British Guiana. The species is not listed in Schomburgk's "Fauna und Flora von Britisch Guiana," although possibly it may be the basis for the otherwise unintelligible report of *C. heterophylla*, l. c. 960 (1848), which is listed as on the Demerara and Essequibo. Of all the cordias collected by the Schomburgks, *Cordia sericicalyx* has the most pronounced dimorphic leaves and hence is the one most apt to be associated with the appropriate but incorrect name, *C. heterophylla*.

The type of *C. sericicalyx* var. *latifolia* Miquel has been examined. It is not separable from the typical form of the species. Miquel gives the type of his variety as *"Kappler 1500."* The type-specimen, however, is clearly numbered *"1510"!*

In defining *C. sericicalyx* I have excluded a very closely related form which seems to replace our Guianan plant across the northern parts of Venezuela and Colombia. This form, called *C. opaca* Rusby, is a more slender plant with more elongate, frequently more or less ribbed, fulvous calyces, very sparsely hairy, short filaments, and firmer, usually more lanceolate leaf-blades.

The specimen of *C. sericicalyx* from Cornelis Kondre is associated with two vernacular names. These are Omosé (Kar.) and Kakóro (Arow.).

14. **Cordia panicularis** Rudge, Pl. Rar. Guian. 30, tab. 46 (1805). *Lithocardium paniculare* (Rudge) Kuntze, Rev. Gen. **2**: 976 (1891).

Shrub or large tree, 3–20 m. tall, dichotomous or trichotomous; branchlets drying dark, sparsely strigose, loosely branched; leaves subhomomorphic, lucent, elliptic to lance-elliptic or broadly lanceolate, 1–2 dm. long, 4–7.5 cm. broad, broadest at or just below the middle, mature leaves usually drying quite brown, apex long-acuminate, base obtuse, both surfaces sparsely strigose or beset with minute very short ascending hairs arising from inconspicuous pustulate bases, lower surface slightly the paler; veins in 5–6 pairs, evident, repeatedly rebranched; petiole 5–10 mm.; cymes loose, 5–30 cm. broad, borne at the forks of the stem; calyx sessile, 5-toothed, 4–5 mm. long, subcylindric or obconic-cylindric, terete or very obscurely angulate, outside rather sparsely strigose, inside densely villous-strigose, becoming explanate in fruit; corolla glabrous, ca. 8 mm. long, lobes obovate to oblong, 2–3 mm. long, filaments hairy near base; ovary and style glabrous; fruit glabrous; stone very rugose, depressed, weakly asymmetric, 8–10 mm. broad.

Known only from the Guianas.

British Guiana: Potaro Landing, clearings and roadsides, shrub 3–4.5 m. tall, 1921, *Gleason 259* (NY, K); Tumatumari, dense upland forest, tall shrub, almost vine-like, 1921, *Gleason 156* (NY, K); Bootooba, sand-hill in forest, Oct. 1924, *Persaud 184* (BD, NY).

Dutch Guiana: near Patricksavanna, in forest, May 1910, *native collector 182* (Utr); Brownsberg Summit, June 1924, tree 20 m. tall, *B. W 6513* and *6519* (Utr.).

French Guiana: Acarouani, fl. white, 1857, *Sagot 448* (K, P); Acarouani, 1854, *Sagot 448* (P); Acarouani, medium-sized tree or shrub, Oct. 1856, *Sagot* (K, P); Cayenne, *Martin ex herb. Rudge* (BM, type); Cayenne, *Martin* (K, P); Cayenne, *Martin 151* (P).

The type of *C. panicularis* is a young flowering branch bearing leaves not yet stiff and somewhat coriaceous as they become in the mature state. Sagot has distributed under an unpublished name, sub no. 448, collections of this species made over several years which show both the young and the mature foliage. Although quite different in appearance I am confident that *C. panicularis* and *C. sericicalyx* are close relatives. The rough depressed glabrous fruits in these species are notably similar. The specimen from Brownsberg Summit is given as called "Berg Tafraboom."

15. **Cordia Sagotii**, sp. nov. *Cordia coriacea* Sagot ex Benoist, Archives Bot. 5, Mem. 1: 257 (1933), not Killip (1927).

Frutex vel arbor 5–10 m. alta, dichotome ramosa; ramulis scabridis pilos minutos numerosos erectos vel ascendentes e basi incrassatos gerentibus; foliis homomorphis ellipticis vel late lanceolatis vel oblongis rigide coriaceis 15–30 cm. longis 7–14 cm. latis medium versus latioribus, basi rotundis vel obtusis vel acutis aliquantum obliquis, apice breviter acuminatis, supra sparse inconspicueque brevi-strigosis, subtus pilis numerosis brevissimis erectis asperatis, nervis 6–8-jugatis abundanter ramosis; petiolis 5–10 mm. longis; cymis saepe in furcis ramulorum ortis sed rariter ut videtur lateralibus, laxissime ramosis 1–3 dm. crassis; calyce in alabastro obovoideo ca. 3 mm. longo sparse striguloso, lobis triangularibus 5; corolla alba fragrante, tubo 4–5 mm. longo, lobis 1.5–2 mm. longis, filamentis 5–6 mm. longis basim versus pilosis; ovario et stylo glaberrimis; fructu glabro flavo; nuce anguste ovoideo erecto ca. 15 mm. longo laevi.

Known only from northeastern Dutch Guiana and northwestern French Guiana.

Dutch Guiana: Sectie O. Reserve, fl. white, Nov. 14, 1917, *B. W. 3414* (Utr); Sectie O. Reserve, tree no. 505, Oct. 23, 1916, *B. W. 1194* (Utr); Sectie O. Reserve, tree no. 506, fruit yellow, April 30, 1915, *B. W. 345* (Utr); Zanderij I. Reserve, tree 176, flower white, fragrant, Nov.

1915, Oct. 1917, Nov. 1919, April 1920, Jan. 1921 and Nov. 1921, *B. W. 1137, 3357, 4433, 4631, 5037* and *5565* (Utr); Zanderij I. Reserve, tree no. 230, fl. white, fragrant, Feb. 1, 1917, Feb. 14, 1917, July 1917, Oct. 1917, and Nov. 1918, *B. W. 2679, 2673, 3026, 3372* and *4067* (Utr.)

FRENCH GUIANA: banks of the Maroni, 1861, *Mélinon 243* (P); Godebert, 1920–21, *Wachenheim 81* and *207* (P); Charvein, fl. white fragrant, shrub 10 m. tall, Dec. 9, 1913, *Benoist 318* (P); Acarouani, medium-sized tree, mature leaves very coriaceous fl. white, fragrant, Dec. 1856, *Sagot 447* (TYPE of *C. coriacea* Sagot and *C. Sagotii*, Paris); Acarouani, 1856, *Sagot 447* (K, P); Acarouani, tall shrub, fl. white, fragrant, mature leaves very coriaceous, 1857, *Sagot 447* (K, BD, P); Acarouani, 1855, *Sagot 447* (K); indefinite, 1863, *Mélinon 63/96;* indefinite, 1862, *Mélinon 412* (P); indefinite, 1802, *Gabriel* (Del).

This species is represented in many herbaria of Europe by various collections of Sagot (all numbered 447). These are all determined as *C. coriacea* Sagot, a name unpublished until Benoist recently used it in his work on the timbers of French Guiana. Benoist has given an adequate botanical description (in French) of Sagot's species. The lengthy description of the wood-structures and the vernacular name, given by him, however, are based upon *Mélinon 88* which represents *Cordia hirta.* Since Benoist's formal botanical description is evidently based upon Sagot's collections and since his binomial was also evidently derived from them, I am content to accept Sagot's species as formally established by Benoist's description, especially since the description was not drawn to include Mélinon's herbarium specimen. Among the several collections of Sagot, obtained in various states of maturity over several years (but all distributed under the same collection-number) I have selected the specimen at Paris collected in Dec. 1856 as the type of *C. coriacea* Sagot. Unfortunately the name *C. coriacea* Sagot is a homonym of an earlier published name. Furthermore its publication by Benoist, because of the lack of a Latin diagnosis, is invalid. For these reasons the plant is described as a new species, *C. Sagotii.* The type is the same as that selected for *C. coriacea* Sagot.

The species is readily recognized by its very large rigid coriaceous leaves which have the midrib markedly bowed and the lower surface scabrous with minute short erect hairs. The glabrous fruit is erectly ovoid and yellow when mature.

The following vernacular names have been found on the labels accompanying specimens from Dutch Guiana—Tafraboom (Surinam Dutch), Kakóro (Arow.), Anoemalatti (Nig. Eng.), Danlieba (Sar.), Dokoa or Dokka (Arow.) and Anaakara (Kar.)—*B. W. 345;* Tafrabom, Arowtroeka (Arow.) and Kokoro konokodikoro (Kar.)—*B. W. 1194;* Tafelboom (Surinam. Dut.), Tafraboom (Nig. Eng.), Boggi lobbi and

Toenba lobbi (Sar.), Kakoro (Arow.) and Aratroeka (Kar.)—*Tree 176 at Zanderij I.*

16. **Cordia hirta,** sp. nov.

Arbor summum ad 20 m. alta, dicho- vel trichotome ramosa; ramulis brunneis saepe fulvo-hirsutis; foliis subhomomorphis ellipticis vel oblongo-oblanceolatis ad medium vel supra medium latioribus 8–18 cm. longis 3.5–7 cm. latis, basi acutis vel obtusis vel plus minusve rotundis, apice abrupte breviterque acuminatis, supra plus minusve scabris pilis abundantibus brevibus rigidis ascendentibus vestitis, subtus plus minusve velutinis pilis gracilioribus erectioribus ornatis, nervis 7–9-jugatis, petiolis hirsutis 4–9 mm. longis; cymis in furcis ramulorum ortis laxe ramosis 1–3 dm. crassis pilis rigidis erectis brunneis vestitis; calyce sessili in alabastro obovoideo 3–4 mm. longo vix costato extus brunneo-hispido intus sparse strigoso, lobis 5 triangularibus erectis; calyce fructifero explanato; corolla 5–6 mm. longa, lobis ca. 1.5 mm. longis rotundis recurvatis, filamentis exsertis basim versus pilosis; ovario et stylo glaberrimo; fructu glaberrimo; nuce anguste ellipsoidea valde ascendente 15–18 mm. longa vix rugosa.

French Guiana to eastern Venezuela, apparently in the mountains back from the coast.

Dutch Guiana: forest near Raleigh Falls, Coppename River, tree 20 m. tall, Aug. 26, 1920, *Pulle 317* (Utr); Raleigh Falls, July 29, 1923, *B. W. 6149* (Utr).

French Guiana: indefinite, 1863, *Mélinon 88* (P); indefinite, 1863, *Mélinon 113* (P).

Venezuela: Arabopo, slopes of Roraima, ¾ mile above Arabopo Swamp, 1260 m. alt., Jan. 1, 1928, *Tate 259* (type, New York); (??) Arabopo, slopes of Roraima, Jan. 1, 1928, *Tate 255* (NY).

This plant evidently frequents the hills. No locality is given for Mélinon's collections but his vernacular names, "Bois Calalon de montagne" and "Cèdre Calalon de serre basse" suggest that the specimens may have come from high ground up the Maroni where he is known to have collected. It is to be noted that the wood sample accompanying *Mélinon 88* is that described by Benoist, Arch. Bot. 5, Mem. **1**: 267 (1933), under the incorrect name of *C. coriacea* Sagot (= *C. Sagotii*). The species is a well marked one with its closest relation probably in *C. Sagotii,* from which it is quickly separable by its smaller leaves, and more copious longer brown pubescence.

17. **Cordia exaltata** Lamarck, Tab. Encyc. **1**: 422 (1791); Poiret, Encyc. **7**: 47 (1806); DeCandolle, Prodr. **9**: 484 (1845). *Lithocardium exaltatum* (Lam.) *Kuntze,* Rev. Gen. **2**: 977 (1841). *Cordia*

mucronata Poiret, Dict. Sci. Nat. **10**: 410 (1818). *Cordia scabrida* Martius ex Fresenius in Martius, Fl. Bras. 8[1]: 11, tab. 9, fig. 12 (1857); Johnston, Contr. Gray Herb. **92**: 62 (1930). *Lithocardium scabridum* (Mart.) Kuntze, Rev. Gen. **2**: 439 (1891).

Shrub or tree, 2–24 m. tall, branching dichotomous; branchlets dark, sparsely strigose; leaves somewhat scabrid, sparsely strigose on both surfaces, commonly more or less heteromorphic, usually drying olivaceous or muddy brown, tertiary veinlets evident; smaller leaves ovate to orbicular, 4–9 cm. long; larger leaves elliptic to broadly oblanceolate, broadest at or above the middle, 8–20 cm. long, 4–10 cm. broad, apex abruptly short-acuminate, base acute to somewhat rounded, veins in 6–8 pairs, petiole 5–10 mm. long, inflorescence borne at forks of stem, loosely branched, 1–2 dm. broad, somewhat scabrous, sparsely strigose or finely hirsute; calyx sessile, sparsely strigose outside, strigose inside the tube, pubescent on the inner face of the 5 regular triangular teeth, in the bud elongate, 4–5 mm. long, 1.5–2 mm. thick, apex rounded, not ribbed, in fruit explanate; corolla white, tube 5–7 mm. long, lobes ca. 2 mm. long, ovate; filaments long exserted, hairy at base; ovary and style glabrous; fruit glabrous, orange-yellow or red; stone ellipsoid, erect or nearly so, 1–1.5 cm. long, not irregularly roughened.

Lower Amazon Valley and along the coast into French Guiana.

FRENCH GUIANA: Cayenne, *Martin* (P); "Cayenne, *Martin*" (herb. Poiret, TYPE of *C. mucronata*); Cayenne, *Perrottet* (Del, P); indefinite, *Leprieur sine no.* (K, Del, DC) and *164* (K, P); indefinite, *Poiteau* (K, Del); indefinite, *Richard* (K, Del); indefinite, *ex Richard* (herb. Lamarck, TYPE of *C. exaltata*).

17a. **Cordia exaltata** var. **melanoneura** [Klotzsch], var. nov. *Cordia melanoneura* Klotzsch ex Schomburgk, Fauna u. Fl. Brit. Guiana 960 (1848), nomen.

A forma typica differt foliis ellipticis vel oblongo-ovatis medio vel infra medium latissimis in sicco plus minusve spadiceis apice longe acuminatis; inflorescentia saepe lata et laxa.

Known only from middle and western British Guiana.

BRITISH GUIANA: Gravee Creek, Kaituma River, N.W. Dist., fairly high tree, Oct. 28, 1908, *Anderson 103* (K); Assakatta, lat. 7° 45′ N., long. 59° 5′ W., Sept. 1923, *La Cruz 4322* (G); Waini River, lat. 8° 20′ N., long. 59° 40′ W., tree 6 m. tall, April 1923, *La Cruz 3855* (G); Santa Rosa, Moruka River, Pomeroon Dist., tree 9 m. tall, fl. white, Aug. 1921, *La Cruz 1015* (G); Moruka River, July 1927, *La Cruz 4522* (G); Waramuri Mission, Moruka River, 9 m. tall, fl. white, Oct. 1922, *La Cruz 2399* (G); Tabla, Pomeroon Dist., fl. white, Sept. 1921, *La Cruz 1224* (G); banks of the Pomeroon, Aug. 1843, *Schomburgk 1398* (BD, TYPE of *C. melanoneura*); Mazaruni River, Aug. 1889, *Jenman 5475* (NY, K, BM); oppo-

site Bartica, April 1887, *Jenman 3625* (K, NY); Moraballi Creek near Bartica, tree 24 m. tall, trunk 25 cm. thick, fl. white, Aug. 26, 1929, *Sandwith 118* (K); Essequibo River, Aug. 1889, *Jenman 5817* (K); indefinite, *Schomburgk 842/1398b* (K), *842* (Del) and *840* (P).

The type of *Cordia exaltata* is said to have come from Richard. In the General Herbarium at Paris there are two good specimens of this species collected by Richard, one bearing mature, and the other very young fruit. Neither collection is provided with exact geographical data though they are provided with the collector's detailed field-notes. The specimen with young fruit, of which Lamarck's type may be a duplicate, is given as "arbor 12–25 pedalis, trunco recto cortice griseo laevissimo, ramis expansis." The other specimen has the following (abbreviated) field-notes, Arbor 20–40 pedalis, ramis patentibus ramosis saepius ternatis, divaricatis; folia sparsa pulchre viridia; bacca elliptica, laevissima, glabra, nitens, flavescens; pulpa glutinosa viscosa; in sylvis variis; dec. fructus maturant.

Poiret's material of his *C. mucronata* consists of two small fragmentary specimens which are so much alike that I believe they are parts of a single collection. Leaves, flowers, and fruit are represented. The material is undoubtedly conspecific with the type of *C. exaltata.* Martin probably collected it about La Gabrielle to the southeast of Cayenne. The species enters French Guiana from the coastal area of Brazil and probably does not extend much northwest of Cayenne.

Cordia scabrida, which has been repeatedly collected in the area about the city of Pará and also about Santarem further up the Amazon, is evidently conspecific with the plant of French Guiana. Exploration will no doubt show that it is present along the north bank of the lower Amazon and in the coastal forests of Brazil towards the Guianan border.

The characters I am able to give for the plant of British Guiana, which I call *Cordia exaltata* var. *melanoneura,* do not separate it sharply from typical *C. exaltata,* but I am of the opinion that the British Guianan plant merits at least varietal and possibly even specific rank. Geographically, it is separated from *C. exaltata* by half of French, half of British, and all of Dutch Guiana. The leaves usually differ in shape and in the characteristic warm brown they assume in drying. Most of the material of the species and variety can be sorted rapidly and accurately merely on the basis of differences in gross aspect. The species *C. melanoneura* first appeared in Schomburgk's book, l. c., where it is said to grow on the banks of the Pomeroon River. This is in the very region in which the var. *melanoneura* has been most collected. The following vernacular names appear on herbarium specimens of the vari-

ety, Table Tree—*Sandwith 118;* Yowanarow and Iguana Tree—*Anderson 103.*

18. **Cordia naidophila,** sp. nov.

Arbor minor dichotome ramosa; ramulis fuscatis dense adpresseque cinereo-hirsutulis; foliis homomorphis ovatis vel elliptico-ovatis 6–11 cm. longis 4–5 cm. latis medium versus vel infra medium latioribus, basi acutis vel rotundis, apice graciliter acuminatis, utrinque scabris pilis abundantibus brevibus rigidis antrorse adpressis asperatis, nervis 5–8-jugatis, nervulis abundanter ramosis, petiolis ca. 5 mm. longis; cymis in furcis ramulorum ortis laxe graciliterque ramosis; calyce strigo in alabastro 2–3 mm. longo 2 mm. crasso subgloboso intus supra medium strigoso, lobis 5 triangularibus; corolla alba tubo 2–3 mm. longa, lobis ca. 2 mm. longis, filamentis ca. 2.5 mm. longis basim versus pilosis; ovario et stylo glaberrimo; fructu glabro; nuce obovoideo erecto ca. 12 mm. longo.

In the upper Amazon Basin, particularly in the drainage of the Rio Negro, Brazil.

VENEZUELA: near San Carlos, headwaters of the Rio Negro, 1853–54, *Spruce 2960* (G).

BRAZIL: Manáos, Agricultural Experiment Station, tree 2.5–3 m. tall, corolla creamy white, Oct. 13, 1929, *Killip & Smith 30008* (TYPE, Gray Herb.); Barra, Oct. 1819, *Martius* (BD); Marary Juruá, Sept. 1900, *Ule 5191* (BD).

This plant of the upper Amazon Basin has been confused with *C. silvestris* Fresen., of the coastal states of southeastern Brazil, but differs in having the upper leaf-surfaces, dull rather than more or less glossy and abundantly rather than very sparsely hairy. The lower surface of the leaves in *C. naidophila* is regularly strigose in a manner quite like the upper surfaces. In true *C. silvestris* the lower face of the leaves is very finely strigose and usually coarsely hairy as well; the upper face is sparsely hairy or nearly glabrous. Specimens of *C. naidophila* have been referred to *C. silvestris* by Fresenius in Martius, Fl. Bras. 8^1: 13 (1857) and by Johnston, Contr. Gray Herb. **92**: 61 (1930).

19. **Cordia grandiflora** (Desv.) Humboldt, Bonpland & Kunth, Nov. Gen. et Sp. **3**: 77 (1818); Fresenius in Martius, Fl. Bras. 8^1: 21 (1857); Johnston, Contr. Gray Herb. **92**: 21 (1930). *Varronia grandiflora* Desvaux, Jour. de Bot. **1**: 273 (1809); Poiret, Encyc. Suppl. **3**: 730 (1814); von Friesen, Bull. Soc. Bot. Genève, sér. 2, **24**: 170, fig. 8 (1933). *Lithocardium grandiflorum* (Desv.) Kuntze, Rev. Gen. **2**: 977 (1891). *Varronia lantanoides* Willdenow ex Chamisso, Linnaea **4**: 492 (1829), in synonymy. *Cordia rufa* Klotzsch in Schomburgk, Fauna u.

Fl. Brit. Guiana 960 (1848), nomen. *Varronia grandiflora* var. *glabrata* von Friesen, Bull. Soc. Bot. Genève sér. 2, **24**: 171, fig. 8e (1933). *Varronia grandiflora* var. *Sprucei* von Friesen, Bull. Soc. Bot. Genève sér. 2, **24**: 148 (1933), nomen.

Shrub, 1–3.5 m. tall; stems clothed with slender appressed hairs; leaves triangular-ovate to lanceolate, with rather conspicuous veins, 4–10 cm. long, 1.5–5 cm. broad, base quite obtuse, margin conspicuously crenate-dentate, upper surface with slender appressed or ascending hairs, usually strigose, lower surface with shorter and more slender hairs, petioles 1–2 cm. long; inflorescence capitate, terminal, 1.5–2 cm. thick, peduncle 5–15 cm. long; calyx coarsely strigose, 7–10 mm. long, lobes long attenuate, the tips linear and free (ca. 2 mm. long) in the bud; corolla white, very large, 3.5–5 cm. long, tube 5–9 mm. long and 2 mm. thick, abruptly expanded into the coarse cylindrical throat (9–14 mm. thick); fruit ca. 9 mm. long, elongate, invested by calyx nearly to its apex.

British Guiana to central Venezuela and southward into the Amazon Valley.

British Guiana: Essequibo, Jan. 1842, *Schomburgk 358* (BD, type of *C. rufa*); Essequibo, *Appun 2514* (K); Mamette, Rupununi River, Oct. 1889, *Jenman 5533* (K).

Venezuela: Ciudad Bolivar, ca. 35 m. alt., June 1931, *Holt & Blake 740* (G); Paloma, lower Orinoco, March 1896, *Rusby & Squires 14* (G, BM, BD); Angostura, *Moritz* (BD).

Brazil: Rio Trombetas, vicinity of Obidos, shrub ca. 25 dm. tall, growing into the water, corolla white, Dec. 1849, *Spruce 515* (G, K, BM); Rio Branco, herbaceous, growing by side of river, corolla white, Sept. 1858, *Schomburgk 817* (K, BM, Del).

This remarkable species was first collected by Humboldt & Bonpland near San Fernando de Apure, Venezuela, just west of the great bend of the Orinoco. The material collected was described as *Varronia grandiflora* by Desvaux. *Cordia rufa* Klotzsch is a name based upon a collection made by Schomburgk (no. 358) on the Essequibo in British Guiana. It has never been described. Schomburgk in his catalogue mentions it only from the upper Essequibo. The Schomburgk brothers, however, made two collections of this species. A study of Robert Schomburgk's field-notes at Kew shows that his collection no. 817, labeled and distributed as from British Guiana, is in fact from Brazil, from the Rio Branco almost certainly between São Joaquin and Pirara.

20. **Cordia polycephala** (Lam.), comb. nov. *Varronia polycephala* Lamarck, Tab. Encyc. **1**: 418 (1791). *Lantana corymbosa* Linnaeus, Sp. Pl. 628 (1753), not *C. corymbosa* Willd. ex R. & S. (1819). *Var-*

ronia monosperma Jacquin, Pl. Rar. Hort. Schoenbr. **1**: 18, tab. 39 (1797). *Cordia monosperma* (Jacq.) Roemer & Schultes, Syst. **4**: 463 (1819). *Varronia dichotoma* Ruiz & Pavon, Fl. Peruv. **2**: 23, tab. 146 (1799), not *C. dichotoma* Forst. (1786). *Varronia ulmifolia* Jussieu ex Dumont-Courset, Le Bot. Cult. ed. 1, **2**: 148 (1802), nomen. *Cordia ulmifolia* (Juss.) DeCandolle, Prodr. **9**: 494 (1845), not *C. ulmifolia* Spreng. (1825). *Varronia corymbosa* Desvaux, Jour. de Bot. **1**: 275 (1809), not "*V. corymbosa* L." ex Desf. (1804), nomen. *Cordia corymbosa* (Desv.) Don, Gen. Syst. **4**: 383 (1838), not *C. corymbosa* Willd. ex R. & S. (1819). *Cordia bifurcata* Roemer & Schultes, Syst. **4**: 466 (1819). *Cordia corymbosa* of Urban, Symb. Ant. **4**: 519 (1910), and most subsequent authors; Johnston, Contr. Gray Herb. **92**: 30 (1930). *Cordia patens* sensu Pulle, Enum. Pl. Surinam 398 (1906). — *Periclymenum rectum, salviae foliis majoribus, etc.*, Sloane, Nat. Hist. Jamaica **2**: 83, tab. 194, fig. 3 (1725). *Ulmi angustifoliae facie Baccifera Jamaicensis etc.*, Plukenet, Phytogr. tab. 328, fig. 5 (1691) and Almag. Bot. 393 (1694).

Slender shrub, 1–5 m. tall, frequently subscandent; stems with appressed or somewhat spreading indument of intermixed short and long hairs; leaves ovate to lanceolate, 2–12 cm. long, 1–5 cm. broad, base acute to obtuse or nearly rounded, apex acute, margin toothed or subentire, upper surface bearing numerous minute limy tuberculations, very sparsely strigose, under surface usually brown, commonly finely and densely tomentulose, on the veins bearing slender appressed or ascending coarser hairs; petiole slender, 3–10 mm. long, decurrent 1–3 mm. on the subtended branchlet and peduncle; cymes usually densely glomerate, subglobose, 5–15 mm. thick, rarely expanding and becoming loosely flowered and the branches more or less evidently dichasial and scorpioid; peduncles axillary and terminal; calyx strigose, 2–3 mm. long, lobes broad, the tips not free in the bud, at maturity calyx tightly investing the fruit nearly to the apex; corolla white, 4–5 mm. long; fruit red, stone 4–5 mm. long, ovoid or subglobose.

Very widely distributed in the warm parts of America.

BRITISH GUIANA: Pirara, Jan. 1842, *Schomburgk 601* (BD); savannas, shrub 3–4 m. tall, fl. white, *Schomburgk 382* (K, BM, Leid. BD, DC, P); Nigate, Nealu, Corantyne River, a few feet tall, Oct. 1879, *Jenman 367* (K); indefinite, *Schomburgk 384* (BM).

DUTCH GUIANA: Matappi, Corantyne River, June 18, 1916, *B. W. 2153* and *2174* (Utr); common on backlands of Paramaribo Gardens, 2–2.5 m. tall, June 1910, *Stockdale 8823* (K); near Paramaribo, frequent, shrub 2.5–3 m. tall, fl. white, Nov. 1837, *Splitgerber 72* (Leid); near Paramaribo, *Focke 755* and *1132* (Utr); near Paramaribo, shrub 2 m. tall, *Kuy-*

per 20 (Utr); near Paramaribo, 1910, *native collector no. 117* (Utr); near Paramaribo, *Kegel 109* (P); edge of forest near Paramaribo, fl. yellow, 1844, *Kappler ed. Hohenacker 1570* (P); Plant. Liberté, edge of forest, fl. white, shrub 2.5 m. tall, 1933, *Lanjouw 223* (Utr); Plant. Rust en Werk, Aug. 5, 1913, shrub 4 m. tall, *Soeprato 60* (Utr); Slootwijk, Commewyne River, roadside shrub 1 m. tall, July 1913, *Soeprato 29G* (Utr); Bloemendal Boite, June 4, 1913, 2 m. tall, *Soeprato 25A* (Utr); Leonsberg, Aug. 8, 1913, *Soeprato 127* (Utr); near Plant. Jagtlust, Aug. 1901, *Went 64* (Utr); Para District, 1919, *Kuyper 20* (Utr); lower Commewyne River near Plant. Maasstroom, *Focke 1358* (Utr); indefinite, *Hostmann 292* (K, BD, P), *Hostmann sine no.* (Leid), *Focke 1355* (G, Utr), and *Leschenault* (P); indefinite, 1841, *Berthoud-Coulon 551* (BM).

Brazil: Rio Negro, Jan. 11, 1887, *Moura 568* (BD); between mouth of Rio Negro and the Capoenas, shrub 2.5 m. tall, July 1851, *Spruce 1695* (K, BM); Igarape Burete, Pracuá, Rio Surumu, Feb. 1909, *Ule 7962* (BD).

Venezuela: lower Orinoco, 1896, *Rusby & Squires 309* (G).

This is the most widely distributed species of *Cordia* in America and, in many regions, one of the commonest. Its nomenclatorial history is involved. Its list of synonyms is a long one. Above I have given merely the oldest names, those published down to and including the Systema by Roemer & Schultes, vol. 4, in 1819. Since 1845 the plant has been called either *C. ulmifolia* or *C. corymbosa*. A study of these names proves them to be illegitimate on several grounds.

The name *C. ulmifolia* was sponsored by DeCandolle, Prodr. **9**: 494 (1845). Those who followed him cited the name "*Cordia ulmifolia* Juss. in Dum. Cour., Bot. Cult. **2**: 148 (1802)." A study of the work cited, however, shows that the name was actually published under *Varronia* and that no description was provided. It is a mere garden name! *Varronia ulmifolia* Juss. was accepted by no one until DeCandolle took it up and transferred it to *Cordia*. Previously, however, Sprengel, Syst. **1**: 653 (1825), had applied the binomial *Cordia ulmifolia* to another concept. *Cordia ulmifolia* (Juss.) DC. is hence a late homonym, besides being based upon a mere garden name.

The name *C. corymbosa* seems to have been introduced by Urban, Symb. Ant. **4**: 519 (1910). It has been universally accepted in recent years. The basic synonymy given by Urban and repeated by subsequent authors is as follows,—*Cordia corymbosa* (L.) Don, Gen. Syst. **4**: 383 (1838) and *Lantana corymbosa* L. Sp. Pl. 628 (1753). The name-bringing synonym is based upon several pre-Linnaean references all of which refer to our concept. *Cordia corymbosa* Don, however, is not based upon *Lantana corymbosa* but upon *Varronia corymbosa* Desvaux, Jour. de Bot. **1**: 275 (1809). This latter name is expressly a renaming of *C. monosperma* Jacq. Both Desvaux l. c. 277 and Don, l. c. 385, cite *Lan-*

tana corymbosa L. among the synonyms of *Varronia* (or *Cordia*) *lineata!!* The name *Cordia corymbosa* Don, can not be used for our plant in any case. It is antedated by *Cordia corymbosa* Willd. ex R. & S., Syst. 4: 801 (1819). Hence, since the name *Cordia corymbosa* Don is not based upon *Lantana corymbosa* L., and since it is invalid through being a later homonym, it must be rejected.

Although it is the oldest name applied to our plant, *Lantana corymbosa* L. can not be transferred to *Cordia* because of two earlier published homonyms. The next oldest name used for our plant is *Varronia polycephala* Lam., which is based upon a phrase-name and illustration given by Plukenet. Transferred to *Cordia* Lamarck's name becomes the correct one for the present concept.

Various names cited by me in my formal list of synonyms have, at one time or another, been involved with binomials which I would refer to other species. The most important of these are *Varronia lineata* L. and *V. humilis* Jacq. Since these two names seem primarily based upon the notes and description given by Browne, Nat. Hist. Jamaica 172, tab. 13, fig. 1 (1759), I identify them with the plant current as *C. globosa* (Jacq.) HBK. Browne's plant has the short pedunculate, terminal, globose flower-heads and the subulate calyx-lobes of that common West Indian species.

The Guianan plants represent the typical West Indian form of *Cordia polycephala,* which is characterized by having the lower surfaces of the leaves densely and finely tomentulose. In South America, the typical form is found in our area, and in the country south along the Andes. One collection from Dutch Guiana, according to the label, is called, "Man blala oema" (*native collector 117*).

21. **Cordia macrostachya** (Jacq.) Roemer & Schultes, Syst. 4: 461 (1819). *Varronia macrostachya* Jacquin, Enum. Pl. Insul. Carib. 14 (1760) and (*C. macrostachia*) Select. Stirp. Amer. 41 (1763); Desvaux, Jour. de Bot. 1: 272 (1809). *Varronia guianensis* Desvaux, Jour. de Bot. 1: 270 (1809). *Cordia gujanensis* (Desv.) Roemer & Schultes, Syst. 4: 460 (1819); (*C. guianensis*) Meyer, Nov. Acta Acad. Caes.-Leop. Car. 12²: 778 (1825). *Montjolya guianensis* (Desv.) von Friesen, Bull. Soc. Bot. Genève sér. 2, 24: 181 (1933). *Cordia interrupta* DeCandolle, Prodr. 9: 491 (1845). *Cordia oxyphylla* DeCandolle, Prodr. 9: 492 (1845). *Lithocardium oxyphyllum* Kuntze, Rev. Gen. 2: 977 (1891). *Cordia graveolens* Humboldt, Bonpland & Kunth, Nov. Gen. et Sp. 3: 74 (1818); Miquel, Stirp. Surinam. 141 (1850); Pulle, Enum. Pl. Surinam 398 (1906). *Varonia martinicensis* sensu Aublet, Hist. Pl. Guian. Fr. 1: 232 (1775); of Poiret, Encyc.

4: 264 (1797), as to *Leblond 370*. ? *Cordia cylindrostachya* sensu Schomburgk, Fauna u. Fl. Brit. Guian. 960 (1848). ? *C. salicina* sensu Garcke, Linnaea **22**: 68 (1849). *Varronia cylindrostachya* sensu Graham, Ann. Carnegie Mus. **22**: 240 (1934).

Shrub 1–2.5 m. tall, younger parts bearing minute resinous granules; stems more or less strigose or with stiff incurved hairs; leaves lanceolate to oblong-ovate, elongate, 5–10 (–20) cm. long, 1–3 (–10) cm. broad, base obtuse or acute, contracted into a petiole 5–20 (–30) mm. long, apex obtuse to acute, margin denticulate to evidently dentate or sinuate-dentate, upper surface smooth to scabrous and characteristically glabrous, bearing small limy tuberculations or murications which are low or somewhat prominent (rarely each bears a very short erect hair), lower surface pale, with soft curved hairs on the veins and veinlets; peduncles terminal, distinct from the petioles, 2–10 cm. long, slender; spikes 5–10 cm. long, becoming rather loosely flowered at maturity; calyx granulate and usually somewhat strigose, ca. 3 mm. long at anthesis, the tips of the triangular lobes not free in the bud; corolla white, ca. 5 mm. long; fruit red, invested to beyond the middle by the cupulate calyx; stone broadly ovoid, 4–5 mm. long.

Northern South America and northward into Central America and the West Indies.

British Guiana: Frechal, dry savanna, shrub, fl. white, fruit red, Sept. 6, 1927, *Tate 37* (NY); Pomeroon River, 25 dm. tall, 1922–23, *La Cruz 3041–3145* (G); Demerara, coastal region, 12 dm. tall, 1881, *Jenman 1501* (K, P); vicinity of Demerara, 1824, *Parker* (DC, type of *C. interrupta*); Georgetown, wild land in the Botanic Garden, fl. white, Oct. 1919, *Hitchcock 16535* (G, NY); coast lands, June 1889, *Jenman 5206* (NY).

Dutch Guiana: Corantyne River, 1911, *Hulk 99* (Utr); near Paramaribo, 1910, *native collector 41* (Utr); near Paramaribo, 2–3 m. tall, *Essed 120* (Utr); near Paramaribo, 1904, *Essed 120* (Utr); Paramaribo, Aug. 1901, *Went 305* (Utr); Paramaribo, June 1903, *Versteeg 464* (Utr); Paramaribo, Jan. 1901, *Went 570* (Utr); Paramaribo, shrub 1–2 m. tall, *Kuyper 34* (Utr); near Paramaribo, shrub 2–2.5 m. tall, fl. white, fruit red, Nov. 1837, *Splitgerber 44* (Utr); Paramaribo near Agricultural Experiment Station, marshy land, fl. white, shrub ca. 1 m. tall, 1933, *Lanjouw 65* (Utr); near Paramaribo on road to Plant. Leonsberg, Aug. 1920, *Pulle H48* (Utr); Leonsberg, 1913, *Soeprato 135* (Utr); between Kwatta and Paramaribo, Feb. 28, 1900, *Tulleken 67* (Leid); Div. Q, forest of Agric. Experim. Station, Paramaribo, 1916, *Samuels 60* (G, K, Leid, BD, P); La Liberté, 1 m. tall, 1913, *Soeprato 235* (Utr); Post Sommelsdijk, lower Commewyne River, July 1913, *Soeprato 37* (Utr); Plant. Domburg near Surinam River, Aug. 23, 1900, *Tulleken 265* (Leid); Para District, in woods, shrub, fl. white, April 1838, *Splitgerber 1160* (Leid); Matappica, Dec., *Focke 279* (Utr); Lawa River, Oct. 1903, *Versteeg 298* (Utr); upper

Commewyne River, in forest, *Focke 213* (Utr); indefinite, *Focke 282* and *446* (Utr), *Tulleken 17* (Leid), *Hostmann sine no.* (Leid) and *Hostmann 323* (K, BM, BD, Del, P); indefinite, 1823–24, *Leschenault* (Leid, P).

FRENCH GUIANA: Acarouani, cultivated, "var. inodora," 1856, *Sagot* (P); Mana, shrub, leaves fragrant, 1857, *Sagot 444* (K, P); Mana, shrubby, leaves fragrant, fl. white, *Sagot 444* (P); Iles du Salut, shrub 5–15 dm. tall, fragrant, fruit red, March 1856, *Sagot* (P); Iles du Salut, shrub with fragrant leaves, 1854, *Sagot 444* (K, BM, P); Cayenne, *von Rohr* (BM); Cayenne, 1853, *Rothery 202* (K, BM) and *sine no.* (BM); near Cayenne in savannas, shrub, fl. white, fruit rose-colored, June 1921, *Broadway 573* (G, NY, K); Cayenne, aromatic shrub, fl. white, fruit red, April 1897, *Soubiron* (P); Cayenne, very common about town, *Richard* (Paris, TYPE of *V. guianensis*); near Cayenne, shrub near sea, fl. white, fruit red, April 1921, *Broadway 49* (G); indefinite, 1820, *Perrottet 212* (DC, TYPE of *C. interrupta*); indefinite, 1792, *Leblond 370* (Del, Lamarck).

The type of *Varronia macrostachya* Jacq. comes from Cartagena. It is briefly described, and then largely through comparison with *V. curassavica* Jacq., but with little doubt is evidently conspecific with our common Guianan shrub. Our plants are remarkably similar to some I have seen from Cartagena. Among the spicate varronias of the coastal area of northern South America *C. macrostachya* is characterized by its glabrous upper leaf-surfaces, usually large leaves, and elongate slender terminal spikes. In dry localities the leaves tend to become smaller and the spikes short. In these phases the plant is distinguished from *C. curassavica* Jacq. only by the absence of hairs on the upper side of the leaves.

Desvaux's *Varronia guianensis* evidently applies to this plant. The vernacular name, "Montjoly," and Aublet's discussion which are mentioned by Desvaux, both apply to our plant. There is a sheet from the Desvaux collections at Paris which is determined as *V. guianensis* by Desvaux. The specimen is labeled merely as from South America, except that it is given as a shrub, no other data concerning it is given on the accompanying label. The specimen, however, is almost certainly a duplicate of one, also at Paris, collected by Richard and labeled as "frequentissima in suburbanis, Cayenne." This information as to locality is that given by Desvaux as the source of his species. I consider the specimens as types of the species.

The type of *C. interrupta* was collected by Perrottet. It is given merely as from French Guiana and it consists of a leaf of *C. tomentosa* and a branch of *C. macrostachya*. A comparison of this type-material in the Prodromus Herbarium with other Perrottet material in the Delessert collections, at Geneva, shows such a close agreement in details of

discoloration, etc., etc., that we may well believe them parts of one collection. The material in the Delessert Herbarium is labeled as from "Mana, 1820, *Perrottet*."

Humboldt and Bonpland collected material near Angostura on the Orinoco which seems to be good *C. macrostachya*. The material, however, was described as a new species, *Cordia graveolens* HBK. Further up the Orinoco, perhaps in very shaded humid locations, there have been collected plants evidently related to *C. graveolens*, though differing in having the upper leaf-surfaces quite smooth and bearing only minute very scattered microscopic limy disks and resinous granulations. This form was described as *Cordia polystachys* HBK. and *C. canescens* Willd., from the Mapure. Spruce (no. 3012) has collected a quite similar plant near the Brazil-Venezuela border. The type of another species, *C. spicata* Willd., given as from Angostura, seems to be an essentially similar form.

The material given as collected by Richard in Cayenne by Poiret, Encyc. **4**: 264 (1797), under the name *Varronia curassavica*, differs from all Guianan plants and is, I believe, West Indian. Desvaux, Jour. de Bot. **1**: 271 (1808), and later Poiret, Encyc. Suppl. **3**: 728–29 (1814), associate this specimen with *V. angustifolia* West. of the island of St. Croix. This is probably correct.

In the Lamarck herbarium there are only two sheets labelled *V. martinicensis*. This material belongs to Leblond no. 370 and is the basis of the description of *V. martinicensis* by Poiret, Encyc. **4**: 264 (1797). Desvaux referred the plant to *V. curassavica*, but I consider it quite representative of *C. macrostachya*.

It should be noted that plants of eastern Brazil (from Ceará southward to Rio Grande do Sul), which I have treated as *Cordia verbenacea* DC., cf. Johnston, Contr. Gray Herb. **92**: 25 (1930), is verly closely related to *C. macrostachya* and perhaps should be accepted as a form of it.

The present species seems to be well known in French Guiana under the name "Montjoly." In several collections from Dutch Guiana the plant is given as called "Blaka oema."

22. **Cordia Schomburgkii** DeCandolle, Prodr. **9**: 490 (1845); Schomburgk, Fauna u. Fl. Brit. Guiana 960 (1848); Garcke, Linnaea **22**: 68 (1849); Pulle, Enum. Pl. Surinam 397 (1906). *Lithocardium Schomburgkii* (DC.) Kuntze, Rev. Gen. **2**: 977 (1891). *Cordia lucida* Splitgerber ex Pulle, Enum. Pl. Surinam 397 (1906), nomen sub *C. Aubletii*. *Cordia tobagensis* Urban in Fedde, Rep. Spec. Nov. **16**: 39 (1919). *Cordia tobagensis* var. *Broadwayi* Urban in Fedde, Rep. Spec.

Nov. **16**: 40 (1919). (?) *Cordia Aubletii* sensu Schomburgk, Fauna u. Fl. Brit. Guiana 960 (1848). *Cordia polystachya* sensu Schomburgk, Fauna u. Fl. Brit. Guiana 1151 (1848). *Cordia patens* var. *polycephala* sensu Miquel, Stirp. Surinam. 140 (1850). *Cordia Aubletii* sensu Pulle, Enum. Pl. Surinam 397 (1906). *Varronia guianensis* sensu Graham, Ann. Carnegie Mus. **22**: 239 (1934).

Shrub 1–4 m. tall; stems with a thin indument of fine curved pubescence and intermixed short coarse curved bristles; leaves ovate to elliptic or lance-elliptic, 5–10 cm. long, 2–7 cm. broad, base obtuse or nearly rounded, apex acute, margin entire to sharply dentate, upper surface drying brown, usually somewhat lustrous, distinctly and simply strigose, lower surface pale, covered with a fine minute curved puberulence, petiole slender 6–9 mm. long, decurrent 5–8 mm. on the subtended branchlet or peduncle; peduncles axillary, slender, ascending, up to 9 cm. long; spikes elongate and loosely flowered, 5–15 cm. long; calyx nearly glabrous, bearing numerous resinous granules, with a few bristles about the apex, the tips of the deltoid lobes not free in the bud, calyx at anthesis or when sterile vase-shaped or funnel-form and 3–4 mm. long, at maturity expanded by the enlarging fruit; corolla white, ca. 4 mm. long; fruit red, tightly ensheathed by the calyx; stone ovoid 4–5 mm. long.

Known only from British, Dutch and French Guiana and from Trinidad and Tobago.

BRITISH GUIANA: banks of the Barama, Oct. 1843, *Schomburgk 1510* (BD); Tumatumari, Potaro River, along trail in forest, shrub 2.5–3 m. tall, fl. white, Jan. 1920, *Hitchcock 17382* (G, NY); Penal Settlement, 1911, *Hitchcock 17150* (K); upper Mazaruni River, long. 60° 10′ W., fl. yellow, 8–12 dm. tall, Sept. 1922, *La Cruz 2343* and *2260* (G, NY); Mazaruni, *Appun 293* (K); Kamakusa, upper Mazaruni, long. 59° 50′ W., Nov. 1922, *La Cruz 2882* (G, NY); Kyk-over-all, near Kartabo, bushy shrub 3 m. tall, July 1924, *Graham 215* (NY); Kartabo, large shrub in clearing, Aug. 11, 1920, *Bailey 170* (G); Kalacoon, shrub in clearing, fruit red, Aug. 23, 1920, *Bailey 170* (G); Kalacoon, shrub 15 dm. tall, along creek, June 1924, *Graham 133* (NY); banks of Rupununi, May 1843, *Schomburgk 1304* (BD, as *C. polystachya*, det. Kl.); Demerara, *Parker* (K); Kamuni Creek, Demerara River, March 1889, *Jenman 4919* (K); Malali, Demerara River, lat. 5° 35′ N., 1922, *La Cruz 2678* (G, NY); Christianburg, Demerara River, 1910, *Anderson 553* (K); Vryheid, Demerara River, fl. white, Feb. 15, 1924, *Linder 61* (G, NY); between Demerara and Berbice rivers, ca. lat. 5° 50′ N., 18 dm. tall, fl. white, *La Cruz 1594* (G, NY); Berbice, 1837, *Schomburgk 406* (Del); indefinite, 1838, *Schomburgk 406* (DC, TYPE of *C. Schomburgkii*; isotypes, K, BM, Leid, BD, P); Canje Creek, Aug. 1908, *Bartlett* (NY).

DUTCH GUIANA: upper Nickerie River, Feb. 24, 1915, *B. W. 1035*

(Utr); Saramacca River, Dec. 1902 and Jan. 1903, *Pulle 125* and *417* (Utr); Heidoti, Saramacca River, 1920, *B. W. 4621* (Utr); road near Paramaribo, 1842, *Focke 816* and *760* (Utr); near Paramaribo, shrub 2.5–3.5 m. tall, fl. white, Dec. 1837, *Splitgerber 206* (Leiden, TYPE of *C. lucida*); Plant. Liberté, lower Surinam, edge of forest, shrub 2–3 m. tall, fl. white, 1933, *Lanjouw 224* (Utr); Para District, forest, fl. white, April 1838, *Splitgerber 1161* (Leid); Para District, June 1904, *Versteeg 507* (Utr); Plant. Guineesche Vriendschap, 1915, *Soeprato 313* (Utr); Carolina Creek, Para River, May 1921, *B. W. 5123* (Utr); near Guyana placer mines, Oct. 1909, *Boldingh 3918H* (Utr); Kadjoe, Surinam River, May 1910, *native collector* (Utr); Koemba Rapids, upper Surinam River, July 1908, *Tresling 232* (Utr, BD); indefinite, *Hostmann* (Leid), *Hostmann 295* (Utr, P), *Hostmann 877* (G, K, BM, Utr, BD, Munich, Del, P), *Kappler 877* (P) and *Focke* (K).

FRENCH GUIANA: St. Laurent du Maroni, shrub 2–3 m. tall, fl. white, Jan. 15, 1914, *Benoist 604* (P); St. Jean, shrub 2 m. tall, fl. white, May 16, 1914, *Benoist 1223* (P); Mana, fl. white, 1858, *Sagot 1169* (K, BM, P); Godebert, Jan. 1920, *Wachenheim 79* (K, BM, P), *101* (G, K, BM, P) and *352* (P).

The species is most nearly related to *C. Poeppigii* DC., of eastern Peru and to *C. ferruginea* (Lam.) R. & S. of the northern Andes and Central America. It is readily recognized by its peculiar calyx. This, when not distorted by the enlarging fruit, is funnel-form or vase-shaped and is abruptly expanded from a short tube (ca. 1–1.5 mm. thick and 1–2 mm. long) or even from the narrow base. The calyx-tube is covered with numerous minute resinous granules. The ascending, more or less deltoid, lobes are somewhat strigose outside especially towards their apices.

The following vernacular names have been found on the labels of the specimens indicated. Black sage—*Anderson 553;* Waijanaka erepaloe—*B. W. 4621;* Baka Oema—*Tresling 232;* Blakka hoema—*B. W. 5123* and Makoeja pipá (Kar.), Kaboejakoro diamaroe (Arow.) and Blakka wintje (Nig. Eng.)—*B. W. 1035.*

23. **Cordia tomentosa** Lamarck ex Roemer & Schultes, Syst. **4**: 459 (1819). *Varronia tomentosa* Lamarck, Tab. Encyc. **1**: 419 (1791); Poiret, Encyc. **4**: 264 (1797); Desvaux, Jour. de Bot. **1**: 268 (1808). *Lithocardium tomentosum* (Lam.) Kuntze, Rev. Gen. **2**: 977 (1891). *Montjolya tomentosa* (Lam.) von Friesen, Bull. Soc. Bot. Genève sér. 2, **24**: 183 (1933). *Cordia Aubletii* DeCandolle, Prodr. **9**: 490 (1845). *Lithocardium Aubletii* (DC.) Kuntze, Rev. Gen. **2**: 976 (1891).

Shrub, 1–4 m. tall; stems clothed with a mixture of curved ascending coarse and slender hairs; leaves lanceolate to ovate-lanceolate or ovate, 7–15 cm. long, 2.5–7 cm. broad, base obtuse or somewhat rounded, apex acute or somewhat acuminate, margin irregularly dentate, upper sur-

face dull, scabrous, with numerous stiff ascending bristles which arise from more or less bulbous bases, lower surfaces pallid, more or less tomentose with abundant fine short interlaced hairs; petioles 5–10 cm. long, decurrent 2–6 mm. on the subtended branchlet or peduncle; peduncles axillary, ascending, 2–10 cm. long; spike broadly clavate, very dense, 1.5–4 cm. long, at anthesis ca. 7 mm. thick, increasing to about twice that thickness in fruit; calyx densely hairy or tomentose with intermixed resinous granules, ca. 5 mm. long at anthesis, much accrescent in maturity, the tips of the lobes evidently free in the bud, calyx-lobes narrowly triangular, very elongate, acuminate; corolla white; fruit tightly invested by the calyx at maturity; stone ca. 4 mm. long.

Known only from French and Dutch Guiana.

DUTCH GUIANA: Voltz Mts., open formation, small shrub 2 m. tall, fl. white, Aug. 22, 1920, *Pulle 252* (Utr).

FRENCH GUIANA: Cayenne, open ground near Baduel, July 10, 1921, *Broadway 720* (G); Cayenne, shrub 4.5 m. tall, fl. white, Feb. 1859, *Sagot* (P); Cayenne, S. Marca savanna near Mt. Baduel, 1867, *Jelski* (BD); Cayenne, 1859, *Sagot 1315* (K, BM, P); Cayenne, *Martin* (K), *Leprieur* (K, Del, P) and *Aublet* (BM); indefinite, *Martin ex herb. Rudge* (BM); indefinite, *Poiteau* (K, BD, Del); indefinite, 1820, *Perrottet 211* (DC).

The present species is most closely related to *C. multispicata* Cham. of eastern Brazil, from which it differs in having the calyx coarsely strigose or tomentose all over, rather than nearly or quite glabrous. The type of *Varronia tomentosa* in the Lamarck Herbarium is labeled as coming from Jussieu and is devoid of any geographic data. It consists of a leaf and a fragment of inflorescence. These, however, evidently represent the much collected plant of the vicinity of Cayenne which is treated here.

There must remain some question as to the proper disposition of the name *Cordia Aubletii* DC. The plant actually described by DeCandolle is Perrottet (no. 211), which represents *C. tomentosa*. The reference by DeCandolle to "*Varronia Martinicensis* Aubl. guian. 232 non Jacq.", which might stand as the basis for the name chosen by him, is quite ambiguous. Aublet quoted a name and a descriptive phrase from Jacquin which apply to a West Indian species. The several lines of discussion by Aublet, concerning the fragrance of the herbage, the color of the fruit, the vernacular name and the local uses of the plant, in fact all the original data, all apply to *C. macrostachya* Jacq. Consequently if the name *C. Aubletii* is taken as founded upon the reference to Aublet's work, the species justly should become a synonym of *C. macrostachya*. I have preferred, however, to associate the name *C. Aubletii* with DeCandolle's specimen from Perrottet and the description of that specimen

published in the Prodromus. It may be further noted that the specimen of *Hostmann 877,* which the younger DeCandolle, in a foot-note, cited as representing *C. Aubletii,* is in fact representative of *C. Schomburgkii.*

In the British Museum there is a collection of *C. tomentosa* made by Aublet. Among his manuscripts I have seen a good description of the species mentioned. It is possible that Aublet identified the plant as *Varronia globosa* and that the report of *V. globosa* in his book, l. c. **1:** 232 (1775), may be based upon his collection of *C. tomentosa.*

24. **Cordia multispicata** Chamisso, Linnaea **4:** 490 (1829); Fresenius in Martius, Fl. Bras. **8**[1]**:** 17, tab. 6 (1857); Johnston, Contr. Gray Herb. **92:** 29 (1930). *Lithocardium multispicatum* (Cham.) Kuntze, Rev. Gen. **2:** 977 (1891). *Cordia bahiensis* DeCandolle, Prodr. **9:** 489 (1845). *Varronia spicata* Salzmann ex DeCandolle, Prodr. **9:** 489 (1845), as synonym.

Shrub becoming subscandent, 1–3 m. tall; stems clothed with a mixture of curved ascending coarse and slender hairs; leaves ovate to ovate-lanceolate, 4–10 cm. long, 2.5–6 cm. broad, base obtuse to rounded, apex acute to somewhat acuminate, margin crenate or dentate, upper surface not lustrous, scabrous, bearing numerous coarse short ascending hairs from bulbous bases, lower surface pale, bearing slender soft curved hairs on the nervation; petioles slender, 4–10 mm. long, decurrent 2–5 mm. on the subtended peduncle or branchlet; peduncle axillary, 1–6 cm. long, ascending; spike broadly clavate to nearly subcylindrical, 1–7 cm. long, short and dense to rather loose and elongate, 7–10 mm. thick; calyx hairy on the lobes, the tube practically glabrous, bearing numerous resinous granules, tip of lobes short but free in the bud, lobes broadly triangular and short acuminate; calyx ca. 3 mm. long at anthesis, accrescent; corolla white, 4–5 mm. long; fruit ensheathed by the calyx at maturity; stone ca. 4 mm. long.

Brazilian, from the mouth of the Amazon southward to Rio Janeiro.

Brazil: beach at Prainha, Nov. 26, 1873, *Traill 561* (K).

This species which has been much collected about the mouth of the Amazon, particularly in the vicinity of Pará, is clearly related to *C. tomentosa* of French and Dutch Guiana. Collecting on the Brazilian coast north of the Amazon will no doubt reveal the presence of the species in that region and possibly may produce forms transitional to *C. tomentosa* as well. *Cordia multispicata* seems to differ from *C. tomentosa* chiefly in its calyx which tends to be entirely glabrous and evidently resinous-granulate below the shorter nearly deltoid lobes. In *C. tomen-*

tosa the calyx-lobes are distinctly more elongate, being narrowly triangular, and have more elongate tips. The calyx-tube in the Guianan plant is hairy all over. In fact, except for the free lobe-tips of the calyx, *C. multispicata* is more suggestive of *C. Schomburgkii* than of *C. tomentosa*.

Doubtful and excluded Species

Cordia flavescens Aublet, Hist. Pl. Guian. Fr. **1**: 226, tab. 89 (1775); Poiret, Encyc. **7**: 43 (1806); Schomburgk, Fauna u. Fl. Brit. Guiana 960 (1848); Johnston, Contr. Gray Herb. **92**: 63 (1930). *Lithocardium flavescens* (Aubl.) Kuntze, Rev. Gen. **2**: 977 (1891). *Cordia sarmentosa* Lamarck, Tab. Encyc. **1**: 422 (1791). *Cordia echitioides* Lamarck ex Dietrich, Synop. **1**: 612 (1839), in synonymy. *Firensia* Scopoli, Intr. 157 (1777).

According to Aublet, l. c. 227, the original material of this species was collected on the Ile de Cayenne and on the adjacent mainland of French Guiana near Tonnegrande. The species is based upon mixed material consisting of (1) flowers of some species of *Cordia*, and (2) fruiting branches of *Ocotea commutata* Nees, of the Lauraceae. Since the species is based upon two entirely discordant elements it must be rejected under article 51 of the International Rules of Nomenclature. At the British Museum and at the museum in Stockholm there are specimens of this species collected by Aublet. These specimens represent only the *Ocotea*.

Cordia lutea Lamarck, Tab. Encyc. **1**: 421 (1791).

A specimen of this species in the Delessert Herbarium is labeled as collected in Cayenne by Perrottet. The species is known only from the semi-arid regions of western Peru and Ecuador and is not even to be expected from the wet Guianan coast. The data on the specimen at Geneva are obviously incorrect. I have had previous occasions to question the accuracy of the geographic data associated with the Perrottet collections in the Delessert Herbarium.

Cordia scandens Poiret, Dict. Sci. Nat. **10**: 410 (1818).

This species is given as collected by Martin in Cayenne. I have seen the fragmentary type in Poiret's herbarium and ample specimens of evidently the same collection in the General Herbarium, also at Paris. A search in the herbarium proved that this authentic material is referrable to *Dichapetalum vestitum* Baill., var. *scandens* [Benth.] Baillon in Martius, Fl. Bras. **12**[1]: 372 (1886). The correct name for that plant, consequently, is **Dichapetalum scandens** (Poir.), comb. nov.

Cordia tetraphylla Aublet, Hist. Pl. Guian. Fr. **1**: 224, tab. 88 (1775); Poiret, Encyc. **7**: 42 (1806); Schomburgk, Fauna u. Fl. Brit.

Guian. 1151 (1848); Fresenius in Martius, Fl. Bras. 8[1]: 13 (1857); Pulle, Enum. Pl. Surinam 397 (1906); Johnston, Contr. Gray Herb. **92**: 64 (1930). *Lithocardium tetraphyllum* (Aubl.) Kuntze, Rev. Gen. **2**: 977 (1891). *Firensia lutea* Rafinesque, Sylva Tellur. 40 (1838).

Aublet, l. c. 226, states that this shrub is very common on the sand near Kourou and westward along the French Guiana coast to Sinnamary. The description given by Aublet is a mixture, based partly upon the flowers of some species of *Cordia* and partly upon a leafy fruiting branch of *Buchenavia capitata* (Vahl) Eichl. of the Combretaceae. The name based upon entirely discordant elements must be discarded.

Cordia Myxa sensu Schomburgk, Fauna u. Fl. Brit. Guiana 830 (1848).

Cordia curassavica sensu Schomburgk, Fauna u. Fl. Brit. Guiana 830 (1848).

Cordia martinicensis sensu Schomburgk, Fauna u. Fl. Brit. Guiana 830 (1848).

The three names above cited are listed by Schomburgk in his catalogue of the plants of British Guiana. The first two are given as cultivated. The last is given as growing wild on plantations and in ditches in the coastal region. I suspect that all three names represent misdeterminations.

2. **Lepidocordia** Ducke, Archiv. Jard. Bot. Rio Janeiro **4**: 170 (1925).

Large tree with broad leaves. Inflorescence a dichotomously branched corymbose panicle. Calyx 5-lobed, persistent. Corolla white, small, 5-merous, with short tube and spreading lobes. Stamens 5, short-exserted. Ovary 4-celled. Stigmas 2, conic, sessile on the apex of the ovary. Fruit unlobed, a drupe, breaking up into 2 flattened bony 2-seeded nutlets. Endosperm present. Cotyledons flat.

A monotype endemic to our area. Its immediate relationships are obscure.

1. **Lepidocordia punctata** Ducke, Archiv. Jard. Bot. Rio Janeiro **4**: 171, tab. 22 (1925); Sandwith, Kew Bull. **1933**: 335 (1933).

Tree 15–30 m. tall, trunk irregularly and very deeply fluted; leaves oblong-lanceolate, broadest at or above the middle, 1–2 dm. long, 2–7 cm. broad, with 6–9 pairs of veins, base obtuse to acute, apex acuminate, upper surface with inconspicuous short erect hairs on the veins and veinlets, minutely and abundantly white-pustulate, lower surface darker with ascending or appressed hairs on the principal veins, petiole 1–2 cm. long; inflorescence stiff, 5–10 cm. broad, flowers crowded at the ends of

the branches, not scorpioid; calyx 2–3 mm. long at anthesis, in fruit twice as large and persistent, lobes lance-ovate, acuminate; corolla white, 2–2.5 mm. long, lobes ovate and about as long as the tube; filaments flattened, glabrous, ca. 1 mm. long, inserted in the middle of the corolla tube; anthers small; ovary glabrous; fruit erect, narrowly obovoid or ellipsoid, glabrous, lustrous, red, 5–7 mm. long, ca. 3 mm. thick.

BRITISH GUIANA: right bank of the Rewa River, ca. 14 miles SSE. of mouth, ca. 90 m. alt. tree 6 dm. in diameter, over 30 m. tall, trunk deeply fluted, growing in Malata (*Mimusops*) Forest on a low hill with red clayey soil, Oct. 7, 1931, *Forest Dept. Brit. Guiana, Field No. D91, record no. 2082* (K).

BRAZIL: Rio Branco de Obidos, northeast of Obidos in the forest called "Repartimento," State of Pará, non-flooded forest, medium-sized tree with fluted trunk, fl. white, Dec. 15, 1913, *Ducke, Jard. Bot. Rio Jan. no. 17864* & *Herb. Amaz. Mus. Pará no. 15152* (K, BD, isotypes); hills near the Rio Branquinho, a tributary of the Rio Branco de Obidos, large tree with trunk excavated and sulcate, fl. white, fruit red, Jan. 27, 1918, *Ducke, Jard. Bot. Rio Jan. no. 17863* & *Herb. Amaz. Mus. Pará no. 16958* (K, BD); forest on Rio Branco de Obidos, elevated place near mouth of Rio Branquinho, large tree with white flowers, Nov. 1, 1919, *Ducke, Jard. Bot. Rio Jan. no. 11406* (BD).

This remarkable tree is known only from the collections cited. Ducke found it on a minor tributary of the Amazon, just to the northeast of Obidos, State of Pará, Brazil. He has made several collections at this type-locality. Members of the Forest Service of British Guiana recently discovered a second locality on the Rewa (or Illiwa) River, between the Rupununi River and the upper Essequibo between 3° and 4° N. lat. This new station is about 650 km. east-northeast of the type-station near the Amazon, and separated from it by the basin of the Rio Trombetas and the headwaters of the Essequibo River. There is every reason to believe that *Lepidocordia* will be found in the intervening region when it is reasonably well explored.

3. **Tournefortia** Linnaeus, Gen. 68 (1754).

Shrubs or woody vines with broad leaves. Inflorescence consisting of scorpioid racemes or spikes borne in dichotomous panicles. Calyx persistent, usually 5-lobed. Corolla white or yellowish, small, usually 5-merous, with cylindrical tube and spreading limb. Stamens usually 5, borne on the corolla-tube, included; filaments short. Ovary 4-celled, style terminal and solitary. Stigma sessile or borne on a distinct style, peltate or conic, fertile on the sides, apex usually bifid. Fruit a drupe, lobed or unlobed at maturity breaking up into 2–4 bony nutlets. Nutlets 1–2-seeded, frequently with 1–2 empty cavities. Endosperm thin. Cotyledons flat.

A genus of about 100 variable and ill-defined species; widespread in the Tropics but evidently centering in America. Type Species, *T. hirsutissima* L.

KEY TO THE SPECIES

Fruit deeply 4-lobed; embryos curved; corolla-lobes linear or long acuminate. § *Cyphocyema.*
- Corolla-tubes short, 1.5–2.3 mm. long, constricted at the throat, lobes linear, nearly as long as the tube; fruit white; plant very slender ..... 1. *T. volubilis.*
- Corolla-tube elongate, 3–8 mm. long, not constricted at throat; lobes broadened below middle, half length of tube or less; fruit yellowish.
  - Herbage sparsely and inconspicuously short-strigose or glabrous, even when young ..... 2. *T. syringaefolia.*
  - Herbage evidently and usually abundantly hairy, especially when young ..... 3. *T. paniculata.*

Fruit obscurely if at all lobed; embryos straight; corolla-lobes broad and rounded. § *Eutournefortia.*
- Style well developed, 2–3 mm. long, evident even on the mature fruit; throat of corolla inflated; fruiting calyces frequently pedicellate ..... 4. *T. Ulei.*
- Style short, the stigma apparently sessile on the mature fruit; throat of corolla constricted; calyx sessile even in fruit.
  - Stems with pale short curving appressed hairs or glabrous; corolla-tube 4–5 mm. long ..... 5. *T. bicolor.*
  - Stems with spreading brown or tawny bristles; corolla-tube 5–8 mm. long.
    - Leaves dull, with abundant long slender hairs; stems with abundant bristles 2–4 mm. long ..... 6. *T. cuspidata.*
    - Leaves glossy, with only scattered hairs along the veins, practically glabrous; stems with only scattered short bristles 1–2 mm. long ..... 7. *T. melanochaeta.*

1. **Tournefortia volubilis** Linnaeus, Sp. Pl. 140 (1753). *T. floribunda* sensu Schomburgk, Fauna u. Fl. Brit. Guian. 1084 (1848).

Slender vine, densely clothed with slender curved hairs; branchlets slender; leaves lanceolate to ovate-lanceolate, 2–10 cm. long, 1–5 cm. broad, base rounded or obtuse, apex acuminate, surface densely strigose or velvety-tomentose, pale or tawny; inflorescence very slender and loosely branched, the spikes becoming 2–10 cm. long; calyx 1–2 mm. long, weakly accrescent, lobes subulate, reaching to beyond middle of corolla-tube; corolla white, tube 1.5–2.3 mm. long, strigose, throat constricted, lobes linear, 1–2 mm. long, spreading; fruit white with black dots, 4-lobed, the lobes subglobose, breaking up into single-seeded nutlets; style developed.

Eastern British Guiana, Venezuela, Colombia and Ecuador, and northward in the West Indies and Central America.

BRAZIL: Roraima, 1842–3, *Schomburgk 732* (BM, P); indefinite, *Schomburgk 732/1110b* (K); indefinite, Jan. 1843, *Schomburgk 1110* (BD).

I believe that the three above cited specimens are parts of a single collection and the basis upon which Schomburgk, l. c. 1084, reported *T. floribunda* from the southern slopes of Roraima. Part of the south slope of Roraima belongs to Venezuela, and it is quite possible that Schomburgk's specimens may have come from within Venezuelan rather than Brazilian territory.

Schomburgk, op. cit. pg. 830, reports *T. volubilis* as occurring about abandoned plantations near the coast of British Guiana, and Aublet, Hist. Pl. Guian. Fr. **1**: 117 (1775), lists it as occurring in French Guiana. I have seen no specimens to substantiate either of these two records. I consider the accuracy of both records extremely questionable.

2. **Tournefortia syringaefolia** Vahl, Symb. **3**: 23 (1794). *Messerschmidia syringifolia* (Vahl) Roemer & Schules, Syst. **4**: 543 (1819); Don, Gen. Syst. **4**: 370 (1838). *T. peruviana* Poiret, Encyc. Suppl. **4**: 425 (1816); Urban, Symb. Ant. **4**: 524 (1910); Johnston, Contr. Gray Herb. **92**: 78 (1930). *T. surinamensis* A. DeCandolle, Prodr. **9**: 526 (1845); Schomburgk, Fauna u. Fl. Brit. Guian. 961 and 1151 (1848); Miquel, Stirp. Surinam. 138 (1850); Pulle, Enum. Pl. Surinam. 398 (1906). *T. Hostmanni* Klotzsch ex Schomburgk, Fauna u. Fl. Brit. Guian. 1151 (1848), nomen. *T. maculata* sensu Lamarck, Tab. Encyc. **1**: 416 (1791) and Poiret, Encyc. **5**: 357 (1804), as to plants in Herb. Lam. *T. laurifolia* sensu DeCandolle, Prodr. **9**: 522, adnot. (1845). *T. foetidissima* sensu De Vriese, Nederl. Kruidkund. Arch. **1**: 347 (1848).

Shrubby vine; branchlets inconspicuously short-pubescent; leaves ovate to lance-elliptic or broadly lanceolate, 4–10(–15) cm. long, 2–5(–8) cm. broad, base acute to rounded, apex acuminate, lower face paler than upper, both faces very sparsely and very inconspicuously short-strigose (even when immature), usually abundantly and very minutely tuberculate, petioles 7–15 mm. long; inflorescence slender, loosely branched, terminal, 5–15 cm. broad, spikes usually less than 5 cm. long even in fruit; calyx 1–1.5 mm. long, weakly accrescent, lobes subulate to ovate; pedicels 0–1 mm. long at anthesis, in fruit becoming 1–5 mm. long and usually much thickened; corolla greenish white, tube 3–4 or even 8 mm. long, limb 3–4 or even 5 mm. broad, lobes 1–1.3 or even 2.5 mm. long, spreading, broad below the middle and above coarsely long-acuminate; fruit yellow or yellowish, usually spotted with black, conspicuously 4-lobed, the lobes subglobose, breaking up into 4 single-seeded nutlets; style developed.

From northern Brazil and Peru northward into the West Indies and Central America.

BRITISH GUIANA: Berbice, Jan. 1896, *Jenman 6925* (K).

DUTCH GUIANA: Plant. Jagtlust, 1913, *Soeprato 38E* (Utr); Para District, scandent shrub, corolla somewhat greenish white, April 1838, *Splitgerber 1159* (Leid, P); Brownsberg Summit, liana with greenish flowers, 1924, *B. W. 6650* (Utr); banks of lower Commewyne River, Dec. 1842, flowers greenish, *Focke 750* (Utr); indefinite, *Hostmann 289* (BD, TYPE of *T. Hostmanni* Kl.; K, BM, P), *Hostmann 951* (Boiss, TYPE of *T. surinamensis;* G, K, BM, Utr, BD, Deles, P), *Hostmann ed. Hohenacker 1721* (P), *Kappler 951* (P), *Kappler 1721* (Utr) and *Focke 180* (Leid).

FRENCH GUIANA: Cayenne, *von Rohr* (Copenhagen, TYPE of *T. syringaefolia,* BM, isotype); Cayenne, *Martin* (K); Cayenne, *Rudge* (BM); near Cayenne, Feb. 12, 1845, *Rothery 207* (K), *sine no.* (BM); Montabo, Cayenne, 1866, *Jelski* (BD).

I have seen the types of all the species listed above. Vahl's species evidently belongs here and is notable chiefly for having the leaf-blade ovate (in accord with its name) rather than lance-oblong as is usually common in this plant. The common form of the species in the Guianas and in northwestern South America is well exemplified by the types of *T. Hostmanni* and *T. surinamensis.* All the material from French Guiana, including the type of *T. syringaefolia,* has corolla-tubes a few millimeters longer than in other South American plants. Similar elongate corolla-tubes, however, are found in the West Indian plants that have been classified, along with all South American forms, as *T. peruviana.* Possibly the difference in corolla-length may merit some nomenclatorial recognition, particularly as both the Cayenne and West Indian forms with elongate corollas also tend to have more ample leaf-blades than the short-tubed plants.

3. **Tournefortia paniculata** Cham. var. **spigeliaeflora** (A. DC.), comb. nov. *Tournefortia spigeliaeflora* A. DeCandolle, Prodr. **9**: 525 (1845); Schomburgk, Fauna u. Fl. Brit. Guian. 1151 (1848); Johnston, Contr. Gray Herb. **92**: 81 (1930).

Similar to *T. syringaefolia* Vahl, differing only in the more abundant and usually more slender and tawny hairs on the herbage, particularly on the immature leaves.

About the margins of the Amazon Basin in southwestern British Guiana, Colombia and Peru; also in Costa Rica.

BRITISH GUIANA: Rupununi near Pirara, Feb. 1842, *Schomburgk 669* (BD); Pirara, etc., *Schomburgk 427* (BM, Deles, P); near Pirara, 1838, *Schomburgk 749* (K, BM, Leid, BD, Deles; DC, TYPE); indefinite, *Schomburgk 427/669b* (K).

The elusiveness and scarcity of characters separating the many rec-

ognizable species of *Tournefortia* are well exemplified by the case of *T. paniculata.* This plant, centering in Brazil and having a distribution generally to the south and east of its close relative, *T. syringaefolia,* is separated from its relative only by quantity of pubescence. This difference is usually very real and tangible. When not, it at least gives to the two forms a perceptible though almost intangible difference in aspect, which coupled with their distinctly natural and credible wide geographic range, leads one inevitably to the conviction that two large genetic entities are concerned. These two species would be united by a stern judge of species-behavior. In his treatment of *Tournefortia,* however, he would be forced to create specific aggregations so large as to be all inclusive and indefinite, or to assemble under his aggregates such an array of subspecific categories as to be cumbersome and impractical. Difficulties in defining and describing species are encountered repeatedly in *Tournefortia* and force the student of the genus to abandon rigid and preconceived notions concerning species values. Testing the subjective matters of plant aspect by the facts of geographic distribution, he must gropingly work out natural concepts of the incipient and unfortunately not yet sharply definable species. The test of the resulting classification of the species of *Tournefortia* is not the imposing number and decisiveness of the key-characters, but the objectivity of the concept judged by one studying masses of material of it and of the group to which it belongs. A study of material of *T. paniculata* and *T. syringaefolia* does justify these two concepts and, as in many other similar cases in *Tournefortia* (e. g. *T. hirsutissima* and *T. bicolor*), does lend support to the universal recognition of these weak but practicable concepts.

The present variety is that race of *T. paniculata,* with tawny somewhat shaggy pubescence, long corolla-tubes and long acuminate corolla-lobes, which occurs about the head-waters of the Amazon and is geographically separated from the typical form of *T. paniculata,* of eastern Brazil and Paraguay, by the great tracts of the Amazon Basin. It is a weak variety but certainly worthy of some recognition. The extreme form is well exemplified by the type-collection of *T. spigeliaeflora,* collected by Schomburgk and labeled as from Pirara. In Robert Schomburgk's notes at Kew the type-number (749) appears in a list of plants (nos. 701–769) sent out to the coast from Pirara on June 25, 1838. In this list only six numbers are provided with definite localities, these all being given as from Pirara. Richard Schomburgk in his published catalogue, l. c. 1151, lists *T. spigeliaeflora* only from the "vicinity of Pirara at the edge of the oasis." This locality is on the margin of the Rio Branco watershed.

4. **Tournefortia Ulei** Vaupel, Notizbl. Bot. Gart. Berlin **6**: 186 (1914); Johnston, Contr. Gray Herb. **92**: 70 (1930). *T. Miquelii* Macbride, Proc. Amer. Acad. **51**: 541 (1916). *T. syringaefolia* of most authors, e. g. Miquel, Stirp. Surinam. 137, tab. 41 (1850); Pulle, Enum. Pl. Surinam 398 (1906), excl. of *Splitgerber 841.*

Shrub or liana; branchlets puberulent; leaves rather thin, ovate or ovate-elliptic or rarely broadly lanceolate, 6–17 cm. long, 3–8 cm. broad, base obtuse, apex acuminate, surfaces glabrous except for inconspicuous puberulence on the veins beneath, frequently with numerous scattered minute usually pale tuberculations; inflorescence loosely branched, the racemes loosely flowered and becoming 2–10 cm. long; calyx 1.5–2 mm. long, weakly accrescent, with triangular or subulate lobes, sessile or shortly and distinctly pedicellate; corolla 7–8 mm. long, greenish white, tube 3–4 mm. long, throat 1–1.5 mm. long, inflated, limb 2–3 mm. broad, lobes ovate ca. 1 mm. long; fruit glabrous, 4–5 mm. thick, not quite so long, broadest below middle; style well developed, becoming 2–3 mm. long, usually persistent; stigma clavate.

Known from the Guianas and in the head-waters of the Amazon south to Bolivia.

British Guiana: Arawak Matope, Cuyuni River, Oct. 1904, *Bartlett 8333* (K); upper Demerara River, Sept. 1887, *Jenman 4117* (K, NY).

Dutch Guiana: Surinam River near Bergendal, *Focke 1308* (Utr, type of *T. Miquelii*); road near Brownsberg, 1910, *native collector 170* (Utr); Commewyne River, *Focke* (K); Surinam, *Focke 121* (Leid).

French Guiana: Maroni River near Apatou, Oct. 1901, *Went 458* (Utr); Ile Portal, Maroni River, May 1857, *Sagot 1011* (K, P); St. Jean, fl. greenish, May 18, 1914, *Benoist 1247* (P); Charvein, fl. green, Jan. 20, 1914, *Benoist 648* (P); Roura, 1858, *Sagot* (P); Cayenne, 1859, *Sagot* (P); indefinite, *Poiteau* (K, BD).

In the Guianas this plant has been generally misdetermined as *T. syringaefolia,* a name properly applicable to the very different plant that has been called *T. peruviana.* The first name for our very distinct species is *T. Ulei,* based upon material collected by Ule in extreme southwestern Brazil. The name *T. Miquelii* Macbr., is based upon a plate published by Miquel, l. c. Since this is evidently drawn from the specimen at Utrecht collected at Bergendal by Focke (no. 1308), that specimen may be considered as the type of *T. Miquelii.* It is quite like *T. Ulei.*

5. **Tournefortia bicolor** Swartz, Prodr. 40 (1788) and Fl. Ind. Occ. **1**: 344 (1797); Johnston, Contr. Gray Herb. **92**: 69 (1930). *T. laevigata* Lamarck, Tab. Encyc. **1**: 416 (1791); Fresenius in Martius, Fl. Bras. 8^1: 49 (1857). *T. laevigata* var. *latifolia* DeCandolle, Prodr.

9: 519 (1845); Schomburgk, Fauna u. Fl. Brit. Guian. 1151 (1848). *T. glabra* Aublet, Hist. Pl. Guian. Fr. **1**: 118 (1775), not Linn. (1753). *T. Aubletii* Macbride, Proc. Amer. Acad. **51**: 541 (1916).

Shrub 1–5 m. tall, becoming subscandent; branchlets with weak short usually sparse ascending appressed hairs, rarely glabrous or puberulent; leaves ovate to elliptic or lance-ovate, 5–14 cm. long, 3–9 cm. broad, subcoriaceous, base obtuse to rounded, apex acute, upper surface slightly lustrous, bearing a few scattered weak short appressed hairs, smooth or bearing very minute inconspicuous papillae, lower surface slightly more hairy than upper; petioles 5–15 mm. long; inflorescence dense, branched, 5–20 cm. broad, racemes becoming 1–4 cm. long; calyx sparsely strigose at anthesis with lobes lanceolate or ovate, 1–2.5 mm. long, weakly accrescent, usually sessile; corolla white, tube 4–5 mm. long, strigose outside, about twice length of calyx, limb 6–7 mm. broad; fruit white, very fleshy, ca. 8 mm. long, glabrous; stigma subsessile.

Widely distributed in the American Tropics.

BRITISH GUIANA: Barima River, 2.5–3.5 m. tall, fl. white, March 1923, *La Cruz 3372* and *3373* (G); Issorora, Aruka River, wet forest, tree 10 m., Jan. 1923, *Hitchcock 17560* (G, NY); Arawak Matope, Cuyuni River, fl. white, Oct. 1904, *Bartlett 8333* (K); near Pirara, Feb. 1842, *Schomburgk* (BD).

DUTCH GUIANA: Coppename River, fl. white Sept. 1901, *Boon 1112* (Utr); banks of Surinam River below Kabel, liana, fl. white, 1933, *Lanjouw 1231* (Utr); Brownsberg, tree no. 66, *B. W. 3243* (Utr); Brownsberg Summit, 1924, *B. W. 6513* and *6714* (Utr); Brownsberg, 1915, *B. W. 711* (Utr); Tapanahoni River, scandent shrub, fl. white, Oct., *Kappler ed. Hohenacker 2094* (BD); Maroni River, shrub 4–5 m., July 1904, *Versteeg 714* (Utr); indefinite, 1862, *Kappler 137* (Leid).

FRENCH GUIANA: La Mana, 1823–24, *Leschenault* (P); Cayenne, 1786–91, *von Rohr* (BM); indefinite, 1820, *Perrottet* (Deles).

5a. **Tournefortia bicolor** var. **calycosa** Donn. Smith, Bot. Gaz. **14**: 27 (1889); Johnston, Contr. Gray Herb. **92**: 70 (1930). *T. Schomburgkii* DeCandolle, Prodr. **9**: 517 (1845); Schomburgk, Fauna u. Fl. Brit. Guian. 961 (1848). *T. alba* Splitgerber ex DeVriese, Nederl. Kruidkund. Arch. **1**: 347 (1848); Schomburgk, Fauna u. Fl. Brit. Guian. 1151 (1848). (?) *T. coriacea* Vaupel, Bot. Jahrb. 54, Beibl. **119**: 3 (1916).

Calyx 3–4 mm. long, the lobes linear or lanceolate; plant tending to be slightly more pubescent than in the species.

Dutch and British Guiana and southwestward across the Amazon Basin to Peru and Ecuador; also in Guatemala and Honduras.

BRITISH GUIANA: Rockstone, bank of Essequibo, July 31, 1921, *Gleason 897* (NY, K); bank of Corantyne River, shrub 2.5–3 m. tall, Sept. 1878,

im Thurn (K, P); Oreala, Corantyne River, trailing over bushes, Nov. 1879, *Jenman 120* (P); Epira, Corantyne River, trailing over bushes, Nov. 1879, *Jenman 65* (P); Berbice, 1837, *Schomburgk 70* (Deles); indefinite, *Schomburgk 70* (DC, TYPE of *T. Schomburgkii;* BM, Leid, BD, P); indefinite, ligneous twiner, fl. white, *Schomburgk 70* (K).

DUTCH GUIANA: Apoera Island, Corantyne River, fl. white, June 22, 1916, *B. W. 2043* (Utr); Wilhelmina Range, Peak no. 1200, June 9, 1926, *B. W. 7060* (Utr); near Plant. Catharina Sophia, Saramacca River, shrub 1–2.5 dm. high, in shade, fl. white, April 1838, *Splitgerber 841* (Leid, TYPE of *T. alba;* isotype, P).

BRAZIL: Rio Negro near confluence with Rio Solimões, May 1851, *Spruce 1491* (G, K, BM).

The widely distributed "*T. bicolor* Sw." is reported by Schomburgk, l. c. 830, as cultivated as a decorative shrub in the coastal regions of British Guiana. *Tournefortia glabra* Aubl. is based entirely upon an unpublished plate by Plumier, (manuscripts at Paris vol. 6, tab. 53). This plate represents *T. bicolor* and is drawn from specimens obtained at Léogane in Haiti. The name *T. Aubletii* Macbr., is a mere renaming of *T. glabra* Aubl., because of an earlier Linnaean homonym. In a strict sense, therefore, both *T. glabra* Aubl. and *T. Aubletii* Macbr. are really West Indian plants.

The var. *calycosa* is based upon material from Guatemala. In Central America it appears to be rare and restricted to eastern Guatemala and adjacent Honduras where it is found in the same regions as *T. bicolor* and *T. hirsutissima*. In South America it occurs in the region to the east and south of the Orinoco Basin and hence far separated from *T. hirsutissima* L., which in South America is known only from northern Venezuela and Colombia. While the var. *calycosa* is not known to grow with *T. bicolor* in South America, it does occur in Ecuador, Peru and the Guianas where the species has been much collected. The variety seems to be a plant of more wet forests than those usually selected by *T. bicolor*. A study of *T. bicolor* from all parts of its very extensive range shows it to be remarkably uniform in the size of its calyx. The uniformly and evidently more elongate calyx-lobes of the var. *calycosa* merit some nomenclatorial recognition particularly since this variation seems to be geographically localized.

The variety has been frequently confused with *T. hirsutissima,* but that species may be readily distinguished from both *T. bicolor* and the var. *calycosa* by its more abundant, more spreading hairs on the herbage, and particularly by the stiff erect or ascending hairs (usually from a somewhat bulbose base) that according to abundance give a hirsute to velvety covering to the upper surfaces of the leaves. The fruit in *T. hirsutissima,* furthermore, is usually hairy. In *T. bicolor* and variety

the somewhat glossy upper leaf-surfaces have weak scattered and commonly inconspicuous appressed hairs. The fruit is glabrous. The stems are usually sparsely hairy or glabrous. The calyx of *T. hirsutissima* is very variable in length. It may be short to elongate in the various parts of the range of the species. The two species, *T. bicolor* and *T. hirsutissima*, are very closely related and the differences separating them are almost exclusively those of pubescence mentioned. The difference seems to be decisive, however, and the resulting concepts natural and practicable.

The type of *T. alba* is the common form of the var. *calycosa*, it has the pubescence, particularly on the stems, sparse and scarcely, if at all, more abundant than is commonly found in *T. bicolor*. The type of *T. Schomburgkii* agrees with other collections from British Guiana in having conspicuously and rather densely hairy stems. In this regard it tends to suggest *T. hirsutissima* with which it has been confused. Schomburgk's original collection of *T. Schomburgkii* (no. 70), was distributed labeled as from "British Guiana" or from Berbice. In his catalogue, l. c. 961, he states that it grows on the banks of the Essequibo and makes no mention of Berbice. In closing it may be added that the type of *T. alba, Splitgerber 841*, was incorrectly cited under *T. syringaefolia* (equals *T. Ulei*) by Pulle, Enum. Pl. Surinam 398 (1906).

6. **Tournefortia cuspidata** Humboldt, Bonpland & Kunth, Nov. Gen. et Sp. **3**: 83 (1818). *T. obscura* A. DeCandolle, Prodr. **9**: 517 (1845); Schomburgk, Fauna u. Fl. Brit. Guian. 961 (1848); Fresenius in Martius, Fl. Bras. **8**[1]: 49, adnot. (1857); Johnston, Contr. Gray Herb. **92**: 68 (1930). *T. setifera* Urban & Ekman, Ark. Bot. **22A**, no. **17**: pg. 94 (1929). *T. hirsutissima* sensu Pulle, Enum. Pl. Surinam 398 (1906).

Shrub or liana; branchlets pubescent, also conspicuously shaggy with abundant slender spreading brown hairs 2–4 mm. long; leaves lance-ovate to lanceolate, 7–15 cm. long, 3–6 cm. broad, base rounded or obtuse, apex acuminate, both surfaces with abundant appressed slender elongate hairs; petioles 5–13 mm. long; inflorescence stiffly and loosely branched, the spikes becoming 1–3 cm. long and crowded at the ends of the elongate branches; calyx-lobes subulate or linear, 7–9 mm. long at anthesis, weakly accrescent, sparsely long-hairy and short-strigose; corolla white, tube 5–8 mm. long, densely strigose outside, limb 4–6 mm. broad, lobes broad; fruit white, fleshy, compressed ovoid, probably ca. 8 mm. long, glabrous, more or less verrucose; stigma sessile.

Northern South America (Dutch Guiana to Colombia) and southward, in the upper reaches of the Amazon Basin, to Bolivia, doubtfully from eastern Brazil; Central America; West Indies.

BRITISH GUIANA: Barima, March 1896, *Jenman 7118* (K); banks of the Quitaro, 1837, *Schomburgk 571* (DC, TYPE of *T. obscura;* G, K, BM, Leid, BD); Berbice, June 1889, *Waby ex Jenman 5157* (K, BM); Berbice, *Burmann* (Deles); Demerara, *Parker* (K).

DUTCH GUIANA: Matappi, Corantyne River, liana, fl. white, June 18, 1916, *B. W. 2168* (Utr); Brownsberg Summit, liana, fl. white, July 3, 1924, *B. W. 6570* (Utr); Goddo, upper Surinam River, Jan. 29, 1926, *Stahel 134* (Utr); Pikien River, fl. white, July 1908, *Tresling 203* (Utr); Maroni River near Armina Falls, small shrub, fl. white, 1933, *Lanjouw 526* (Utr); indefinite, *Hostmann 227* (K, BM, Utr, BD, Deles, P).

I have examined the types of the species above cited. They are evidently conspecific! The type of *T. obscura* is *Schomburgk 571,* labeled as from the banks of the Quitaro. The specimen was collected by Robert Schomburgk. A study of his manuscript list at Kew shows that no. 571 falls within the gamut (no. 511–588) of numbered collections sent out from Curassawaka (on the Essequibo) in Dec. 1837. According to the list these numbers apply to specimens from "the Quitaro in November and to a few on the River Rewa, but the greater part of the high numbers from the mountains of Attarypou [Kanuku Mts.]." Only one number is provided with a definite locality, no. 581 being given as from the "mountains of Attarypou." The list gives the following field-notes for no. 571, "A ligneous twiner growing by river side, leaves light-green, a shade lighter below, calyx light green, petals and organs of fructification pure white, fruit a white berry." In Richard Schomburgk's published catalogue, l. c. 961, *T. obscura* is reported from the banks of the Rupununi, Rewa and Quitaro rivers.

In my paper on the Brazilian species of *Tournefortia* I reported this species, sub *T. obscura,* doubtfully from eastern Brazil. At Paris I have since seen a collection by Glaziou (no. 9981) labeled as from "São João da Barra" on Feb. 8, 1876. This locality is at the mouth of the Parahyba River in the northeastern section of the State of Rio Janeiro. The same number is cited by Glaziou, Bull. Soc. Bot. France **57,** Mem. **3e:** 478 (1910), under the name *"T. Salzmanni"* and as from "São João, près Campos." At Kew this collection by Glaziou, no. 9981, is labeled as cultivated at Rio Janeiro. The species has evidently been collected in eastern Brazil but whether or not from cultivated plants is still to be settled.

7. **Tournefortia melanochaeta** DeCandolle, Prodr. **9:** 520 (1845).

Shrub or liana; branchlets with scattered spreading brown hairs 1–2 mm. long; leaves lance-ovate, 9–11 cm. long, 5–6 cm. broad, base obtuse to rounded, apex acuminate, both surfaces lustrous and glabrous except for a very few slender appressed hairs along the midrib and veins,

petioles 10–13 mm. long; inflorescence stiffly and loosely branched, spikes becoming 10–15 mm. long and crowded at the ends of the elongate branches; calyx-lobes glabrous, lanceolate to linear, 4–7 mm. long, weakly accrescent; corolla white, tube 5–7 mm. long, densely strigose outside, limb 4–5 mm. broad, lobes broad; stigma sessile; fruit unknown but probably as in *T. cuspidata*.

Known only from French Guiana.

FRENCH GUIANA: "Cayenne ou Guyane française," *Museum de Paris, 1821* (DC, TYPE); Cayenne (*Martin*) ex Museo Horti Paris, 1819 (BD); Cayenne, *Martin* (G, P).

The material cited is evidently all part of one large collection by Martin. It seems to be scarcely more than a glabrescent phase of *T. cuspidata*, a species which extends, from the westward, to the borders of French Guiana, though it is not as yet known to have been collected within that colony.

DOUBTFUL AND EXCLUDED SPECIES

Tournefortia gnaphalodes (Linn.) R. Brown ex Roemer & Schultes, Syst. **4**: 538 (1819).

Schomburgk, Fauna u. Fl. Brit. Guian. 830 (1848), reports this plant from the coasts of British Guiana, while Lamarck, Encyc. **3**: 94 (1789), and Aublet, Hist. Pl. Guian. Fr. **1**: 117 (1775) under the name *Heliotropium gnaphalodes*, indicate its occurrence in French Guiana. The plant is widely distributed in the West Indies but does not reach south to Trinidad. I have seen no material of it from the Guianan coast and, furthermore, do not believe that it is native in the region.

Tournefortia foetidissima Linnaeus, Sp. Pl. 140 (1753).

Tournefortia hirsutissima Linnaeus, Sp. Pl. 140 (1753).

Tournefortia cymosa Linnaeus, Sp. Pl. ed. 2, 202 (1762).

The above three species are listed by Aublet, Hist. Pl. Guian. Fr. **1**: 117–118 (1775), as occurring in French Guiana. They are West Indian species not known from the Guianas and, furthermore, not to be expected there.

Tournefortia incana (Meyer) Don, Gen. Syst. **4**: 368 (1838), not Lamarck (1791).

Tournefortia Meyeri DeCandolle, Prodr. **9**: 530 (1845).

The above two names are based upon *Messerschmidia incana* Meyer from the mouth of the Essequibo. The plant seems to be a species of *Heliotropium*.

4. **Heliotropium** [Tournef.] Linnaeus, Gen. 63 (1754).

Mostly low herbaceous or suffrutescent plants, rarely shrubs; leaves small to large. Inflorescence of solitary, geminate or ternate scorpioid spikes or racemes or the flowers solitary cauline and internodal. Calyx persistent or deciduous, with 5 teeth or lobes. Corolla yellow, white or blue, small, 5-merous, tube cylindrical, limb spreading. Stamens 5, borne in the corolla-tube, included, filaments short. Ovary 4-celled; style terminal, solitary; stigma sessile or on a distinct style, peltate or conic, fertile on the side, apex bearing a conic or cylindrical sterile appendage that is usually bifid or bidentate. Fruit dry, lobed or unlobed, at maturity breaking up into 2–4 bony nutlets. Nutlets 1–2-seeded, frequently with 1–2 sterile cavities. Endosperm developed.

A large genus widely distributed in the warmer regions of the world. Type Species, *H. europaeum* L.

KEY TO THE SPECIES

Plant distinctly succulent, entirely glabrous, frequently somewhat glaucous ..... 1. *H. curassavicum.*

Plant not succulent, more or less pubescent, not glaucous.

Flowers borne singly along the leafy stems; fruit contracted into a conic apex ..... 2. *H. lagoense.*

Flowers borne in well developed scorpioid spikes or racemes.

Corolla blue or purple; fruit glabrous, ribbed, angulate, deeply 2-lobed with the lobes horizontally divergent; plant coarse, erect, more or less hirsute with large evidently veined leaves 3–10 cm. broad ..... 3. *H. indicum.*

Corolla white; fruit strigose, rounded, weakly 4-lobed vertically; plant rather slender, erect or decumbent; leaves with appressed pubescence, very obscurely veined, less than 2 cm. broad.

Leaf-blades elliptic to broadly oblanceolate, 5–20 mm. broad, petiole 4–15 mm. long; racemes mostly geminate or ternate, bractless ..... 4. *H. procumbens.*

Leaf-blades linear to oblanceolate, 1–8 mm. broad, petiole 1–2 mm. long; racemes always single, bearing small lanceolate bracts 1–2 mm. long.

Corolla 4–6 mm. long, anthers joined at their apices; stigma borne on a short but evident style; stems comparatively coarse and stiff; leaves drying rather light colored ..... 5. *H. ternatum.*

Corolla 2–2.5 mm. long, anthers not joined apically; stigma sessile on the fruit; stems wiry, very slender, leaves usually drying dark colored..... 6. *H. filiforme.*

1. **Heliotropium curassavicum** Linnaeus, Sp. Pl. 1: 130 (1753); Schomburgk, Fauna u. Fl. Brit. Guian. 961 (1848); Johnston, Contr. Gray Herb. 81: 14 (1928).

Annual or short-lived perennial, succulent, glabrous; stems prostrate or decumbent, 1–3 dm. long, ascendingly branched; leaves narrowly to broadly oblanceolate, 2–4 cm. long, 3–10 mm. broad, fleshy, frequently somewhat glaucous; flowers borne in bractless single or geminate scorpioid spikes 1–10 cm. long; calyx ca. 1.5 mm. long at anthesis, over 2 mm. long at maturity, sessile or subsessile, lobes broadly cuneate to triangular-ovate; corolla white, 2–3 mm. long, lobes ca. 1 mm. long, tube shorter than calyx; anthers 0.6–1 mm. long, sagittate, apex with acuminate appendage, not joined together; fruit weakly 4-lobed, epicarp slightly fleshy and wrinkled in drying; style sessile, disk of stigma broad; nutlets 4, equal, oblong, 2–2.5 mm. long, 1-celled, 1-seeded.

From the coast of British Guiana, Venezuela and Colombia southward along the west coast of South America to central Chile and Patagonia, and northward through the West Indies and in Central America to southern-most United States.

BRITISH GUIANA: Georgetown, *Hitchcock 16572* (G, NY); indefinite, seashore, June, 1889, *Jenman 5471* (US, BM); indefinite, *Jenman 2165* and *4466* (NY).

The species is listed as occurring in French Guiana by Aublet, Hist. Pl. Guian. Fr. **1**: 117 (1775). I consider this record very questionable. It may be noted that I have examined and made dissections of the type of *H. Lehmannianum* Bruns, Mitt. Inst. Allg. Bot. Hamburg, **8**: 69, fig. 10 (1929), recently described from the coast of southern Peru. My study has shown the type to be quite ordinary *H. curassavicum*. Bruns described and illustrated remarkable developments in corolla-lobing and in anther-shape. In the various dissections made on the type I could find no suggestion of remarkable structures, the corolla and the anthers agreeing perfectly with the familiar typical West Indian *H. curassavicum*.

2. **Heliotropium lagoense** (Warm.) Gürke in Engler & Prantl, Nat. Pflanzenf. IV. Abt. **3a**: 97 (1893); Johnston, Contr. Gray Herb. **81**: 49 (1928). *Schleidenia lagoensis* Warming, Kjoeb. Vidensk. Meddel. **1867**: 15 (1868). *Heliotropium trinitense* Urban, Symb. Ant. **7**: 350 (1912).

Annual herb with scattered slender appressed hairs; stems slender, prostrate, 5–30 cm. long, ascendingly branched; leaves oblanceolate, 0.5–1.5 cm. long; flowers borne singly along the leafy stems, extra-axillary; calyx of 5 unequal lanceolate or cuneate lobes, at anthesis 1.5–2 mm. long, becoming about twice as long in fruit; pedicels 1–3 mm. long, ascending; corolla white, 3–4 mm. long, funnelform; lobes ovate, 1–1.5 mm. long; sinus rounded, plaited, occasionally with a minute

lobule; anthers oblong, bearing an obese hairy apical appendage nearly as large as the anther proper, anthers joined together by their appendages; fruit glabrous or nearly so, subterete, base rounded, from at or below middle contracted upwardly into a broad conic or short-rostrate apex; nutlets 4, ca. 1.5–2 mm. long, single seeded.

Northern Dutch Guiana, Trinidad, northern Venezuela, eastern Bolivia, and eastern and western Brazil; not common and apparently local and erratic in distribution.

DUTCH GUIANA: "Suriname," Jan. 1885, *Suringar* (Leid).

This species is frequently confused with *H. filiforme*, which it resembles in its wiry stems and slender leaves, but it is readily distinguished from that plant by its conic fruit and its cauline internodal flowers. Although Suringar's collection has no definite locality it is to be supposed that it is from the vicinity of Paramaribo where Suringar is known to have done most of his collecting in Dutch Guiana.

3. **Heliotropium indicum** Linnaeus, Sp. Pl. 130 (1753); Aublet, Hist. Pl. Guian. Fr. **1**: 117 (1775); Pulle, Enum. Pl. Surinam 399 (1906); Johnston, Contr. Gray Herb. **81**: 19 (1928). *Heliophytum indicum* (Linn.) DeCandolle, Prodr. **9**: 556 (1845); Schomburgk, Fauna u. Fl. Brit. Guian. 831 and 961 (1848).

An erect coarse weedy annual herb, usually more or less pale-hirsute, 1–10 dm. tall, mostly branched above the middle; leaves ovate or elliptic to broadly lanceolate, herbaceous, veined, 5–15 cm. long, 3–10 cm. broad, margin repand or undulate, apex acute, base obliquely acute to subcordate, petioles 4–10 cm. long, winged just below the leaf-blade; flowers borne in bractless single scorpioid spikes becoming 5–30 cm. long; calyx with subulate or cuneate lobes 2–2.5 mm. long, somewhat accrescent in fruit; corolla blue or violet or exceptionally white, salverform, tube 2.5–4.5 mm. long, evidently surpassing the calyx, limb 2–4 mm. broad; anthers elongate, the apices not united; style short and slender; fruit glabrous, strongly ribbed, deeply 2-lobed (the lobes spreading) and breaking up into 4 angulate nutlets 2–3 mm. long.

A Pan-Tropic weed, probably of American origin.

BRITISH GUIANA: Comaca, Moruka River, *La Cruz 1058* (NY, US); Waranuri Mission, Moruka River, Oct. 1922, *La Cruz 2600* (G, NY, US); Kamakusa, upper Mazaruni River, Nov. 1922, *La Cruz 2748* (G, NY); Tumatumari, *Gleason 370* (NY); Hyde Park, east bank of Demerara River, *Dahlgren* (FM); Demerara, *Parker* (K); Georgetown, weed along canal, fl. white, 1919, *Hitchcock 16684* (G, NY, US); Epira, banks of Corantyne River, Nov. 1879, *Jenman 54* (K); Corantyne River, Oct. 1879, *im Thurn* (P); indefinite, *Schomburgk 206* (BD) and *600* (K).

DUTCH GUIANA: bank of Corantyne River, 1911, *Hulk 33* (Utr); sand

near Maripaston, Saramacca River, Nov. 1902, *Pulle 4* (Utr); Paramaribo, fl. bluish, *Kuyper 25* (Utr); near Paramaribo, fl. blue, Dec. 1837, *Splitgerber 338* (Leid, P); Combee, Paramaribo, Aug. 1901, *Went 319* and *332* (Utr); Plant. Rust en Werk, 1913, *Soeprato 57* (Utr); upper Surinam River near Saida, 1908, *Tresling 346* (Utr); Plant. Slootwijk, Commewyne River, 1913, *Soeprato 151* (Utr); beach facing Cottica Mt., Lawa River, fl. white with yellowish throat, light lilac when young, Oct. 1903, *Versteeg 289* (Utr); Cottica River near Moengo, marshy ground, fl. light blue, 1933, *Lanjouw 403* (Utr); indefinite, *Focke 1370* (Utr).

FRENCH GUIANA: Maroni, *Wachenheim 287* and *290* (P), *291* (BM); St. Jean, fl. pale blue, April 26, 1914, *Benoist* (P); St. Jean, fl. pale blue with yellowish center, March 8, 1914, *Benoist 1154* (P); St. Laurent du Maroni, Jan. 1908, attractive to butterflies, *LeMoult* (P); Acarouani 1855, about dwellings, fl. bluish, *Sagot 449* (P); vicinity of Cayenne, fl. purple, May 6, 1921, *Broadway 118* (K); Cayenne, Feb. 18, 1845, *Rothery 165* (BD); Iles du Salut, 1854, fl. pale bluish, *Sagot 449* (BM, P).

BRAZIL: Obidos, *Spruce 476* (K); Monte Alegre, 1873, *Traill* (K).

VENEZUELA: Ciudad Bolivar, 1931, *Holt & Blake 838* (G); Las Batillas, *Passarge & Selwyn 301* (BD); Puerto Ayacucho, 1931, *Holt & Blake 834* (G).

In Dutch Guiana this species is called "Kaha Kankay" (*Tresling no. 346*) and "Kokorrode" (*Pulle no. 4*) and is given as being used with salt as a cure for gas on the stomach (*Versteeg no. 289*). According to Aublet, l. c., it is called "Cret-de-Coq" in French Guiana and an infusion of the flowers used "pour arrêter les pertes de sang chez les femmes."

4. **Heliotropium procumbens** Miller, Dict. ed. 8, no. 10 (1768); Johnston, Contr. Gray Herb. 81: 52 (1928). *Heliotropium inundatum* Swartz, Prodr. 40 (1788).

Annual herb with more or less abundant slender appressed hairs, plant usually cinereous; stems erect or decumbent, 1–5 dm. long, ascendingly branched; leaves with elliptic, obovate or broadly oblanceolate blades, 1–4 cm. long, 5–20 mm. broad, petioles slender 4–15 mm. long; flowers borne in slender scorpioid racemes, racemes mostly geminate or ternate, bractless, elongating, becoming 2–10 cm. long, peduncles 1–4 cm. long; calyx with 5 unequal lanceolate or linear lobes, at anthesis 0.5–1 mm. long, becoming 1–2.5 mm. long in fruit, pedicels ca. 0.5 mm. long; corolla white 1–5 mm. long, lobes ovate, short, with rounded sinus; anthers ovate, contracted apically into short narrow appendages, anthers not joined apically; fruit depressed globose, 4-lobed, strigose; stigma sessile; nutlets strigose, 0.5–1 mm. long.

Northern Argentina northward through Tropical America to southern United States; rare in the very wet regions.

BRITISH GUIANA: indefinite: *Appun 1762* (K), *Schomburgk 1024* (K, BD) and *1026* (K).

BRAZIL: Prainha, *Traill* (K); Alemquer, *Spruce* (K).

5. **Heliotropium ternatum** Vahl, Symb. Bot. **3**: 21 (1794); Johnston, Contr. Gray Herb. **81**: 69 (1928). *Heliophytum passerinoides* Klotzsch ex Schomburgk, Fauna u. Fl. Brit. Guian. 1152 (1848), nomen. *Schleidenia Fumana* Fresenius in Martius, Fl. Bras. **8**[1]: 40 (1857). *Heliotropium Fumana* (Fresen.) Gürke in Engler & Prantl, Nat. Pflanzenf. IV. Abt. **3a**: 97 (1893); Johnston, Contr. Gray Herb. **81**: 71 (1928). *Heliotropium* sp., Oliver, Trans. Linn. Soc. London, Bot. **2**: 279 (1887). *Heliotropium strictissimum* sensu N. E. Brown, Trans. Linn. Soc. London, Bot. **6**: 51 (1901). *Heliotropium fruticosum* of authors, not Linnaeus.

Suffrutescent, with abundant ascending or appressed hairs; stems erect or decumbent, 1–5 dm. long, ascending branched; leaves lanceolate to linear, revolute, 1–3 cm. long, 1–8 mm. broad, with slender petiole 1–2 mm. long; flowers borne in stiff scorpioid racemes; racemes single, elongating and becoming 2–15 cm. long, bearing scattered lanceolate bracts 2–3 mm. long; calyx at anthesis 2–3 mm. long, consisting of 5 more or less unequal lanceolate lobes, becoming twice as large in maturity; pedicels 0.5–1 mm. long; corolla white, 4–6 mm. long, lobes ovate, sinus rounded and plicate; anthers ovate with short obtuse hairy apical appendages which are apically joined to one another; fruit depressed globose, 4-lobed, strigose; style short but evident; nutlets 1–1.5 mm. long.

Central America and the West Indies, northern Colombia and Venezuela, southern British Guiana and eastern Brazil; chiefly in open places or in dry thickets.

BRITISH GUIANA: Kamakot, Ireng River, 1884–85, *Jenman 3* (US); Konkarmo, Ireng Valley, Nov. 16, 1884, *im Thurn 3* (K, BM); Ireng Valley, *Quelch & McConnell 220* (K, BM) and *302* (K); Rupununi, *Appun 2203* (K); Rupununi, May 1842, *Schomburgk 573* (BD, TYPE of *H. passerinoides*); Pirara, etc., 1841–42, *Schomburgk 282* (P); indefinite, gravelly savanna, leaves appear farinaceous, fl. white, 1836, *Schomburgk* (K).

In and about the West Indies *H. ternatum* is generally recognized as a variable species in habit, pubescence and leaf-shape. The typical and most common form of it has loosely revolute leaves 3–5 mm. broad and a loosely appressed indument of slender hairs. This plant appears to be rare or absent in our area. In the Guianas the species seems to be represented only by a form found in the savannas near the Brazilian border. This has linear leaves 1–3 mm. broad and is silky strigose. It is quite like plants from eastern Brazil that have been described as *H. Fumana*. In my monograph, l. c. **81**: 69–71 (1928), *H. Fumana* was

treated as doubtfully distinct from *H. ternatum*. Subsequent consideration of its relation with *H. ternatum*, in the light of new material, has led me to the belief that it is only a pronounced form, possibly a savannaecad of that species. Much of the material from the dry eastern corner of Brazil, which formerly I placed in *H. Fumana* (and even some that I placed in *H. salicoides* Cham.) I now refer unhesitatingly to *H. ternatum*. Only the material with narrow sublinear leaves and distinctly silky strigose indument should be placed under *H. Fumana*. This form comes from more interior, more moist localities than those in which *H. ternatum* is usually found. Transitional forms are common. If the linear-leaved, silky-strigose form of the savannas needs to be recognized, it may be called **Heliotropium ternatum** var. **Fumana** (Fresen.), comb. nov.

Both *H. ternatum* and the variety may be distinguished from *H. salicoides* by having white rather than bright yellow corollas. The leaves also dry much lighter in color in *H. ternatum* and the pubescence of the herbage is not so strongly spreading and so coarse as in *H. salicoides*. Warming's *Schleidenia subracemosa*, which I placed under *H. salicoides*, I now refer to *H. ternatum*. *Schleidenia dasycarpa* Fresen. is also based upon material referable to *H. ternatum*. I have recently examined the types of these Brazilian species.

The only Guianan specimen of this species at Berlin that was collected by Schomburgk (no. 573) is labeled as from the Rupununi. It bears Klotzsch's name, *Heliophytum passerinoides*, and is evidently the type of that undescribed species. Schomburgk, in his published list, however, gives *H. passerinoides* Kl. only from the savannas near the Takutu River. That stream joins the Ireng not far west of Pirara which in its turn is even a shorter distance west of the Rupununi. All of Schomburgk's specimens, under their various labels, probably came from the general region to the west of Pirara. From this region *H. ternatum* var. *Fumana* extends up the Ireng where others have collected it.

The typical form of the species is either very rare or absent in the coastal region of the Guianas. Possibly the region is too wet. The description of the puzzling *Messerschmidia incana* Meyer, from the mouth of the Essequibo, suggests *H. ternatum* in all except the fruit. The doubt surrounding Meyer's plant, however, forces me to leave it unplaced.

6. **Heliotropium filiforme** Lehmann, Götting. Gel. Anzeigen **1817**: 1515 (1817) and Asperif. **1**: 37 (1818); DeCandolle, Prodr. **9**: 545 (1845); Pulle, Enum. Pl. Surinam 399 (1906); Johnston, Contr. Gray Herb. **81**: 61 (1928). *Schleidenia filiformis* (Lehm.) Fresenius in Mar-

tius, Fl. Bras. 8^1: 40 (1857). *Heliotropium helophilum* Martius, Flora Regensb. 21^2, Beibl. 4: 85 (1838) and Herb. Fl. Bras. p. 165, no. 267 (1841); DeCandolle, Prodr. 9: 544 (1845); Schomburgk, Fauna u. Fl. Brit. Guian. 961 (1848); Miquel, Stirp. Surinam. 136, tab. 40 (1850).

Annual herb, sparingly strigose; stems slender, erect or decumbent, 1–4 dm. long, ascendingly branched; leaves 1–2.5 cm. long, 1.5–3.5 mm. broad, oblanceolate, petiole very slender, 1–2 mm. long; inflorescence consisting of very slender scorpioid racemes, these solitary, elongating, becoming 2–15 cm. long, bearing minute scattered lanceolate bracts, 1–2 mm. long; flowers 1–3 mm. distant, strict, numerous; calyx of 5 unequal lanceolate or lance-ovate lobes, at anthesis 1.5–2 mm. long, becoming about twice as long in fruit, pedicels becoming 0.5–1 mm. long in fruit; corolla white, funnelform, 2–2.5 mm. long; lobes ovate with broad open sinus, ca. 1 mm. long; anthers each contracted into a short puberulent apical appendage, not coherent; fruit depressed globose, obscurely 4-lobed, strigose; stigma sessile or subsessile; nutlets almost 1 mm. long.

Eastern Bolivia and Paraguay northward through Brazil to Venezuela and the Guianas; also in Trinidad and British Honduras; growing in sand, usually near water.

British Guiana: Essequibo River, Demerara, 1881, *Jenman 1095* (K, P); Essequibo, Jan. 1842, *Schomburgk 321* (BD); upper Rupununi, *Appun 2394* (K); Pirara, 1845, *Schomburgk 228* (BD, P); Berbice, sandy soil, 1837, *Schomburgk 351* (K, BD, P); indefinite, *Schomburgk 228/321b* (K).

Dutch Guiana: Corantyne River, sandy places near Wonotobo, 1916, *B. W. 2866* (Utr); Avanavero Rapids, Kabalebo River, in sand, 1920, *B. W. 4653* (Utr); island in Lucie River, sandy soil, 1910, *Hulk 398* (Utr); lower Saramacca River, in sand, Nov. 1902, *Pulle 69* (Utr); lower Surinam River, April 1846, *Kappler, ed. Hohenacker 1810* (Utr, BD); Maroni River, rocks at Armina Falls, 1901, *Went 467* (Utr); Maroni River near Bonnidoro, in sand, fl. white, *Kappler, ed. Hohenacker 2095* (BD); Lawa River, sandy flat, Oct. 1903, *Versteeg 277* (Utr); indefinite, 1862, *Kappler 158* (Leid).

French Guiana: Maroni, 1862, *Rech* (P); Cayenne, *Martin* (P); Cayenne, 1853, *Rothery 209* (Cambr.); Oyapock, Oct. 1844, *collector not given, no. 269* (K).

Brazil: Monte Alegre, *Traill 570* (K); middle Rio Cuminá, Dec. 24, 1928, *Sampaio 5906* (BD); Rio Cuminá, Cataract of Tronca, Sept. 18, 1928, *Sampaio 5011* (BD); Rio Trombetas, Lag. Caypurú, *Traill 568* (K); Barra Rio Negro, *Spruce 1115* (G, K).

Venezuela: Angostura, 1864, *Grosoudy* (P); Puerto de Tablas, Canton de Upata, 1864, *Grosoudy* (P); Tigrito, *Passarge & Selwyn 515* (BD); Las Botillas, *Passarge & Selwyn 302* (BD).

Doubtful and Excluded Species

Heliotropium fruticosum L. ex Aublet, Hist. Pl. Guian. Fr. 1: 117 (1775).

Although listed by Aublet I believe that this species does not occur in French Guiana. The binomial was applied to *H. ternatum* in many of the older books. But neither this latter species nor the one properly called *H. fruticosum* is known or even to be expected in French Guiana.

Heliotropium latifolium Willd. ex Schomburgk, Fauna u. Fl. Brit. Guian. 961 (1848).

Listed by Schomburgk as distributed through the forests in the northern parts of British Guiana. The species (and the cited synonym, *H. scorpioides* HBK.) is a synonym of *H. angiospermum* Murray (= *H. parviflorum* L.). Although this plant is known from eastern Brazil and from northern Venezuela, no specimens have been seen from the Guianas.

Messerschmidia incana Meyer, Prim. Fl. Esseq. 92 (1818). *Tournefortia incana* Don, Gen. Syst. 4: 368 (1838), not Lamarck (1791). *Tournefortia Meyeri* DeCandolle, Prodr. 9: 530 (1845); Schomburgk, Fauna u. Fl. Brit. Guian. 1151 (1848).

The description given by Meyer makes it evident that this plant must be a *Heliotropium*, rather than a *Tournefortia*, if indeed it really is a member of the Boraginaceae at all. The original description strongly suggests *H. ternatum* Vahl in all but the fruit, which is given as consisting of two biovulate sub-trilocular nutlets. The type was collected on the west bank of the Essequibo River near its mouth, where it is given as growing in dry places. Until the type (probably at Goettingen) is examined the species must remain very puzzling and unplaced.

Herbarium, Arnold Arboretum,
Harvard University.

HANDELIODENDRON, A NEW GENUS OF SAPINDACEAE

Alfred Rehder

With plate 119 and one text figure

Handeliodendron, gen. nov.

Flores ut videntur hermaphroditi, symmetrici, satis parvi, albescentes; sepala 5, libera, imbricata, ovato-oblonga vel oblonga, obtusiuscula, uninervia, ciliolata, extus intusque puberula, basin versus ut pedicellus squamulis patelliformibus obsita; petala 4 vel interdum 5, sepalis duplo longiora, imbricata, oblonga, obtusiuscula, basin versus sensim in unguem attenuata, supra basin lamellis 2 elevatis instructa, extus adpresse pubescentia, intus glabra, ciliolata, medio reflexa; discus lateralis pulvinaris, irregulariter lobulatus, latere staminibus opposito concavus, fere aeque latus quam altus; stamina 7, raro 8, inaequalia, longiora petalis subaequilonga, sed ob petala recurvata manifeste exserta, filamentis leviter sursum curvatis, apice excepto villoso-pilosis, antheris late ovalibus mucronulatis, infra medium dorsum affixis; ovarium late fusiforme, longiuscule stipitatum, in stylum brevem apice stigmatibus 3 brevissimis conicis coronatum attenuatum, triloculare; ovula in quoque loculo 2, alterum erectum, alterum pendulum. Capsula piriformis, leviter 3-loba vel abortu 2-loba vel simplex, stipitata, loculicida, pericarpio coriaceo brunneo lenticellis albidis consperso; semina in quaque capsula 1–4, ovoidea, testa crustaceo-coriacea, atra, nitida, hilo brunneo parvo elliptico, arillo albido duplici circiter semen medium tegente, e trichomatibus cohaerentibus constituto, exteriore hilum cingente ab interiore annulo incrassato separato. Embryo vix curvatus, cotyledonibus plano-convexis fere rectis, basi tantum curvatus et in radiculam dorsalem gracilem in plica testae immersam et fere ad micropylem descendentem contractus.

Arbor alta, cortice griseo, ramulis hornotinis brunneis glabris, annotinis lenticellatis spadiceis. Folia opposita, glabra, digitata, foliolis 5 inaequalibus petiolulatis ellipticis vel elliptico-obovatis, abrupte in acumen caudatum productis, bais late cuneatis in petiolulum decurrentibus, supra laete viridibus subtus pallidioribus et glandulis scutellatis initio fusco-rubris demum nigrescentibus sparse vel sparsissime conspersis, pinnatinerviis, nervis utrinsecus 9–12 patentibus arcuatis supra levissime subtus magis elevatis margine anastomosantibus, costa supra elevata sed in canaliculo plus minusve immersa subtus manifeste elevata; petio-

lis gracilibus teretibus basi tantum leviter sulcatis estipulatis. Panicula terminalis, plus minusve longe pedunculata, pyramidalis, laxa, multiflora, pedicellis squamulosis exceptis glabra, ramulis oppositis, in dichasia pluraque triflora exeuntibus, pedicellis gracilibus squamulosis bracteis bracteolisque deciduis instructis; alabastra ovoidea.

Species unica Chinae provinciae Kweichou incola.

Handeliodendron Bodinieri (Lévl.), comb. nov.

Sideroxylon Bodinieri Léveillé, Fl. Kouy-Tchéou, 384 (1915).

Character generis.

Petiolus 4–11 cm. longus; foliola basalia terminali saepe duplo minora, 3–12 cm. longa et 1.5–6.5 cm. lata, petiolulis 1–15 mm. longis; panicula pedunculo 3–5 cm. longo excluso circa 10 cm. longa et lata, pedicellis 2–5 mm. longis; sepala 2–3 mm. longa; petala 9 mm. longa et 2 mm. lata; stamina 5–9 mm. longa, antheris 0.75 mm. longis; ovarium stylo brevissimo incluso 1.25 mm. longum, stipite 1.5 mm. longo. Capsula stipite circiter 1 cm. longo incluso 3.2 cm. longa; semina circa 1 cm. longa.

CHINA. Kweichou: district de Ly-po, *J. Cavalerie* in herb. Bodinier, no. 2626, Sept. 1898 (fruit), May 11, 1899 "grand arbre" (holotype of *Sideroxylon Bodinieri* in herb. Léveillé, Bot. Gard. Edinb.); Mapo, Pingchow, alt. 500 m., common in light woods, *Y. Tsiang,* no. 6813, Aug. 30, 1930, "tree, bark dark gray, branchlets lenticellate, fruit reddish, seeds black" (in Herb. Nat.-hist. Mus. Wien ex Herb. Metrop. Mus. Nat. Hist. Acad. Sin. Nanking).

Though *Handeliodendron* resembles in its opposite digitately 5-foliolate leaves the Hippocastanaceae, it shows in its other characters a closer affinity with the Sapindaceae and is best placed with the tribe Harpullieae on account of the 2-ovuled locules, the symmetrical flower, the dehiscent fruit, the not spirally curved embryo and the presence of a terminal leaflet. The genus exhibits a number of characters unusual or rare in the family, as the opposite digitate leaves, flowers with 7 stamens, stipitate ovary and a unilateral disk, and seeds with a double arillus and straight embryo. Opposite leaves are very rare in the family, they occur in *Valenzuela* and some species of *Matayba,* digitately 5-foliolate leaves are still rarer and are only found in a few species of *Allophylus* as in *A. dimorphophyllus* Radlk., though ternate leaves occur in a number of genera as *Delavaya, Hypelate, Llagunoa, Thouinia,* and *Allophylus;* also the double arillus is very rare. The wood, but not the bark and other parts of the plant, contains saponin according to Dr. Handel-Mazzetti.

The solitary flowering specimen I have seen has only the terminal

Sideroxylon Bodinieri (Lévl.) Rehd.

flowers of the dichasia at the end of the branches fully open, all the other flowers are in bud. The open flowers as well as the flowers still in bud seem to have normal ovaries and normal anthers; all the open flowers have 4 petals, while in at least some of the flowers in bud I counted 5 petals; in one flower I found 8 stamens. The description of the seeds is based on notes and on drawings kindly furnished me by Dr. Handel-Mazzetti, since I did not feel at liberty to dissect the solitary fruit of the type specimen. He had identified Tsiang's no. 6813 which

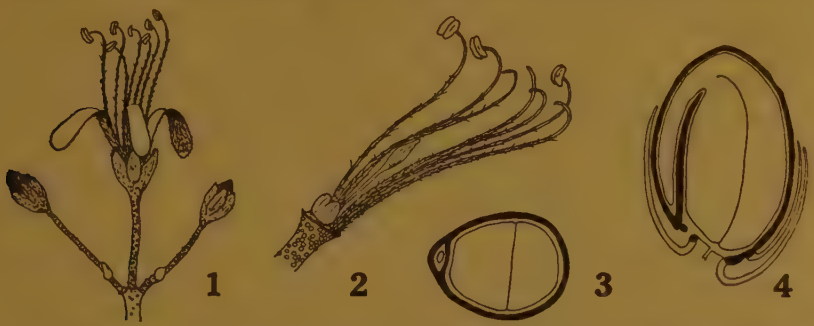

FIGURE 1. HANDELIODENDRON BODINIERI (Lévl.) Rehd. 1. Flower (× 2). 2. Flower with sepals and petals removed (× 4). 3. Cross-section of seed (× 3). 4. Longitudinal section of seed, showing the double arillus, the inner one interrupted above the micropyle (× 3).

is in fruit as belonging to the same species as Bodinier's flowering specimen, after I had sent him a photograph of the type of *Sideroxylon Bodinieri* Lévl. with a detached flower. A photograph of Tsiang no. 6813 kindly sent me with a detached fruit by Dr. Handel-Mazzetti confirmed the identity of the two specimens.

I take pleasure in naming this interesting and distinct new genus in honor of Dr. H. Handel-Mazzetti, who has collected extensively for several years in China and whose critical account of the plants of his and other collections in his Symbolae Sinicae is one of the most important contributions to our knowledge of the flora of China.

HERBARIUM, ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

NOTES ON SOME OF THE EBENACEAE AND VERBENACEAE OF THE SOLOMON ISLANDS COLLECTED ON THE ARNOLD ARBORETUM EXPEDITION, 1930–1932[1]

R. C. BAKHUIZEN VAN DEN BRINK

With plates 120–122

EBENACEAE

Diospyros ellipticifolia (Stokes) Bakhuizen, Enum. Mal. Eben. in Gard. Bull. Str. Settl. 7(2): 162 (1933).

Maba elliptica J. R. et G. Forster, Char. Gen. Pl. 122, tab. 6 (1776).

Ysabel Island: Tiratoña, alt. 600 m., *Brass* 3318, ♂, flor., Dec. 8, 1932. — Vernacular name "Gaitutunu."

Diospyros ferrea (Willd.) Bakhuizen, Enum. Mal. Eben. in Gard. Bull. Str. Settl. 7(2): 162 (1933).

Maba buxifolia (Rottb.) A. L. Jussieu in Ann. Mus. Hist. Nat. 5: 418 (1804).

Diospyros ferrea var. **salomonensis** Bakhuizen, var. nova.

Subsimilis D. ellipticifoliae, sed staminibus 9, foliis submajoribus differt.

Ramuli teretes, rugosi, dense tuberculatim lenticellati. Folia elliptica vel oblongo-lanceolata, basi obtusa vel rotundata, apice obtusa vel breviter obtuse acuminata, 5–20 cm. longa, 3–7 cm. lata, chartacea vel tenuiter coriacea, supra atro-viridia, nitida vel statu sicco subopaca, subtus pallidora, primum subtus appresse pubescentia, denique costa excepta utrinque glabra, nervis lateralibus utrinsecus 7–10 vel pluribus, utrinque subinconspicuis, venis reticulatis laxis utrinque subprominulis invisibilibus; petiolus semiteres, appresse rufo-pubescens, glabrescens, 0.3–0.5 cm. longus. Flores masculi sessiles, 3–5-ni, cymosi vel in

[1] In the latter part of 1930 Mr. S. F. Kajewski, in continuation of his botanical work on behalf of the Arnold Arboretum in the New Hebrides and North Queensland, left Brisbane for Bougainville Island and the British Solomon Islands. He resigned in June 1931 and in July 1932 his place was taken by Mr. L. J. Brass, who remained there until December 1932 when he returned to Brisbane, and after a few weeks left for Papua as botanist to the Archbold Expedition of the American Museum of Natural History, New York. Mr. C. T. White, Brisbane, to whom the collections have been entrusted for arrangement, advises that they have now been roughly sorted into families. Several of these have been sent to specialists for critical examination, and we have already received determinations of the Ebenaceae and Verbenaceae from Dr. R. C. Bakhuizen van den Brink. The descriptions of the new species, new varieties and of one new combination are offered herewith. The list of other determinations will be included in the general account of the Bougainville and Solomon Islands collection to be published at a later date.—Ed.

pseudo-racemis dispositi; calyx urceolatus, 3-dentatus, in anthesi saepius rumpens, intus versus apicem appresse rufo-pubescens; corolla albida, versus lobos purpurascens; stamina 9, sublibera, glabra. Fructus ellipsoideus vel subglobosus, primum appresse pubescens, maturitate glabrescens, flavescens, 1.5–2 cm. longus, 1.5–1.75 cm. diam.; calyx fructifer subpatelliformis, marginibus reflexus, extus sparse appresse pubescens, glabrescens, rugulosus, intus toto superficie sericeus, 1–1.2 cm. diam.; semina oblonga, triquetra, utrinque acuta, facie recta, dorso convexa, a latere compressa, rugulosa, nigra, 1.2–1.5 cm. longa, 0.5–0.7 cm. lata, 0.5 cm. crassa; albumen aequabile.

Ulawa Island: *Brass* 2958, ♀, fruct., Oct. 5, 1932. Ysabel Island: Jaukau, *Brass* 3152, ♂, flor., Nov. 19, 1932. — Vernacular names "Aibul" (under no. 2958) and "Gno-gno-finete" (under no. 3152).

Diospyros insularis Bakhuizen, Enum. Mal. Eben. in Gard. Bull. Str. Settl. 7(2): 173 (1933). PLATE 120, 121

Arbuscula. Folia elliptico-oblonga, basi cordata, apice breviter obtuse acuminata, supra atro-viridia, statu sicco olivacea, subopaca, nervis lateralibus 7–12 distantibus, secus marginem non vel indistincte anastomosantibus, utrinque prominentibus; petiolus subteres vel apicem versus subdepressus. Fructus axillaris, sessilis, plerumque solitarius, ellipsoideus vel subglobosus, utrinque rotundatus, primum sericeus, statu maturo glabratus, ruber, statu sicco niger, rugulosus, opacus, 2–2.5 cm. diam.; calyx fructifer viridis, valde accrescens, extus glaber, 3.5–4 cm. diam., tubo crasso, plano-cupuliforme, subquadrato, intus rufo-sericeo, rimo elevato, 2–2.5 cm. diam., lobis late ovatis obtusis vel suborbicularibus, coriaceis, patulo-recurvis vel reflexis, striato-nervosis, utrinque glabris, 1–1.5 cm. longis, basi 1.5–1.75 cm. latis; semina usque ad 8, oblongo-ellipsoidea, triquetra, dorso convexa, a latere compressa, ca. 1.5 cm. longa, 0.7 cm. lata, 0.4–0.5 cm. crassa; testa rugulosa, nigra; albumen aequabile.

Ysabel Island: Maringe, *Brass* 3166, ♀, fruct., Nov. 22, 1932.

Diospyros maritima Blume, Bijdr. Flor. Ned. Ind. 669 (1825).

Ysabel Island: Sigana, alt. 100 m., *Brass* 3450, ♀, fruct., Jan. 11, 1933. — Vernacular name "Gegila."

Diospyros samoensis A. Gray in Proc. Amer. Acad. 5: 326 (1861).

San Christoval Island: Star Harbor, *Brass* 3073, ♂ flor., Oct. 18, 1932. Ngela Group: Nayotana Island, *Brass* 3240, ♀, fruct., Nov. 16, 1932.

VERBENACEAE

Avicennia marina (Forsk.) Vierhapper, Beitr. Kennt. Flor. Südarab. in Denkschr. Akad. Wiss. Wien, **71**: 435 (1907).

Avicennia marina var. **resinifera** (Forst.) Bakhuizen, Rev. Gen. Avic. in Bull. Jard. Bot. Buitenz., ser. **3**(2): 210, tab. 16 (1921).

Malaita Island: Quoimonapu, sea level, *Kajewski* 2344, Dec. 11, 1930. — Vernacular name "Bu-bula."

Callicarpa pedunculata R. Brown, Prod. Flor. Nov. Holl. 513 (1810).

Guadalcanal Island: Berande River, sea level, *Kajewski* 2420, Jan. 7, 1930. — Vernacular name "Bau."

Callicarpa pentandra Roxb., Flor. Ind. **1**: 409 (1820) var. **typica** (Schau.) Bakhuizen, forma **genuina** Bakhuizen in H. J. Lam. & Bakhuizen, Rev. Verb. in Bull. Jard. Bot. Buitenz., sér. 3, **3**(1): 12 (1921).

Bougainville Island: Kieta, sea level, *Kajewski* 1560, March 21, 1930; Kupei Gold Field, alt. 950 m., *Kajewski* 1643, April 7, 1930; Kugu-maru, Buin, alt. 150 m., *Kajewski* 1841, June 9, 1930. San Cristoval Island: Waimamura, alt. 200 m., *Brass* 2625, August 10, 1932. — Vernacular name "Sor-ku-ku" (under no. 1841).

Callicarpa pentandra var. **paloensis** (Elm.) Bakhuizen, forma **furfuracea** Bakhuizen in H. J. Lam & Bakhuizen, Rev. Verb. in Bull. Jard. Bot. Buitenz., sér. 3, **30**: 15 (1921).

Malaita Island: Quoimonapu, sea level, *Kajewski* 2340, Dec. 11, 1930. Guadalcanal Island: Ma-massa, Konga, alt. 400 m., *Kajewski* 2485, Feb. 12, 1931; Vulolo, Tutuve Mt., alt. 1200 m., *Kajewski* 2540, April 20, 1931. — Vernacular names, "Quoi-esa" (under no. 2340), "Kim-berri" (under no. 2485) and "Kimberi" (under no. 2540).

Clerodendron Buchanani (Roxb.) Walpers, Rep. Bot. Syst. **4**: 108 (1845).

Bougainville Island: *Kajewski* 1606, March 29, 1930; Karngu, Buin, sea level, *Kajewski* 2222, Oct. 6, 1930. San Cristoval Island: Waimamura, *Brass* 3140, Oct. 1932. Ysabel Island: Sigana, alt. 20 m., *Brass* 3465, Jan. 13, 1933. — Vernacular name "Arka-koo" (under no. 2222).

Clerodendron confusum Hallier f. in Meded. Rijks Herb. Leiden, **37**: 65 (1918).

Bougainville Island: Kupei Gold Field, alt. 900 m., *Kajewski* 1687, April 11, 1930; Kugu-maru, Buin, alt. 150 m., *Kajewski* 1925, August 4, 1930; same locality, *Kajewski* 1978, August 23, 1930. Malaita Island: Quoi-mon-apu, sea level, *Kajewski* 2341, Dec. 11, 1930. Guadalcanal Island: Vulolo, Tutuve Mt., alt. 1200 m., *Kajewski* 2502, April 14, 1931. San Cristoval Island: Hinuahaoro, alt. 900 m., *Brass* 2919, Sept. 22, 1932. Ysabel Island: Tiratoña, alt. 600 m., *Brass* 3403, Dec. 29, 1932. — Vernacular names "Koru-kopu" (under no. 1925), "E-ya-papor" (under no. 1978), "Kaka-fair" (under no. 2341), "Ambus-gor-le-le" (under no. 2502) and "Fuho" (under no. 3403).

This species is closely related to *C. buruanum* Miq. which differs in the much longer corolla-tube and also to *C. infortunatum* L., which has a glabrous corolla and a longer corolla-tube. Nevertheless all these species may perhaps be considered as only extreme forms of *C. infortunatum* L.

Clerodendron inerme (L.) Gaertner, Fruct. Sem. Plant. **1**: 271, tab. 75 (1788).

Bougainville Island: Karngu, Buin, sea level, *Kajewski* 2244, Oct. 12, 1930. Guadalcanal Island: Berande, sea level, *Kajewski* 2407, Jan. 5, 1931. — Vernacular names "Pumb-arg-aru" (under no. 2244) and "A-la-loi-alugi" (under no. 2407).

Faradaya amicorum (Seem.) Seemann in Jour. Bot. **3**: 258 (1865).
Clerodendron amicorum Seemann in Bonplandia, **10**: 249 (1862).

Faradaya amicorum var. **salomonensis** Bakhuizen, var. nova.

Frutex flexuosus plerumque scandens, primum appresse pubescens, denique glabrescens, in ramulis florigeris cinereo-subsericeus. Folia valde variabilia, lanceolata-oblonga vel obovata, utrinque attenuata, basi acute vel obtuse cuneata, apice breviter subacute acuminata, utrinque glabra, 7–20 cm. longa, 3.5–10 cm. lata, nervis lateralibus distantibus, utrinsecus 5–7. Inflorescentiae axillares vel in paniculis speciosis terminalibus dispositae, multiflorae, cymis subinde trichotomis, basi conspicue bracteolatis; bracteolae oblongo-ellipticae vel sublanceolatae, utrinque sericeae, 1–2.5 cm. longae, 0.3–1 cm. latae. Flores subparvi, in alabastro globosi, pedicellati; pedicelli teretes, graciles, cinereo-sericei, basi bracteolati, 0.5–1.5 cm. longi; calyx primum subclausus vel apice poro dehiscens, denique truncatus vel margine undatus, vel dentatus vel etiam distincte lobatus, 0.5–0.6 cm. longus, 0.7–1 cm. diam., fructifer accrescens, saepius irregulariter ruptus, extus sparse pubescens, basi excepta glabrescens; corolla alba, hypocrateriformis, utrinque

glabra, tubo variabili, 1–1.5 cm. longo, lobis ovatis vel suborbicularibus, glabris, margine ciliatis; stamina longe exserta, glabra; ovarium quadrangulare vel 4-lobatum, glabrum; stylus filiformis, teres, glaber, usque ad 3 cm. longus. Fructus submagnus, abortu 1-pyrenus; pyrena elongata, nucleis reductis appendiculiformibus basi suffulta, monosperma, glabra, 3–4 cm. longa, 1.5–2 cm. diam.

San Cristoval Island: Waimamura, alt. 50 m., *Brass* 2635, August 11, 1932. Ysabel Island: Tiratoña, alt. 600 m., *Brass* 3399, Dec. 29, 1932. — Vernacular name "Naosokoño."

Perhaps this is not really different from the typical form, but it has a glabrous corolla.

Gmelina moluccana (Bl.) Backer in Heyne, Nutt. Plant. Ned. Ind. 4: 118 (1917); Bakhuizen in H. J. Lam & Bakhuizen, Rev. Verb. in Bull. Jard. Bot. Buitenz., sér. 3, 3(1): 67 (1921).

San Cristoval Island: Waimamura, sea level, *Brass* 2860, Sept. 12, 1932.

Gmelina salomonensis Bakhuizen, spec. nova. PLATE 122

Arbor speciosa. Ramuli crassi, teretes, novelli rufo-tomentosi, vetustiores glabrescentes, sparse lenticellati. Folia opposita, longe petiolata, coriacea, ovata vel oblongo-elliptica, basi cordata vel subtruncata, apice acuminata, obtusa, integerrima, 15–35 cm. longa, 10–24 cm. lata, supra viridia, lucida, primum sparse pubescentia, denique costa et nervis exceptis glabra, subtus grisea, submolliter rufo-tomentosa, basi nonnullis glandulis parvis obsessa, costa supra leviter subtus valde prominente, utrinque glabrescente, nervis lateralibus utrinsecus 12–18 pallidis, supra prominulis glabris, subtus prominentibus rufo-tomentosis, venis reticulatis utrinque prominulis. Inflorescentiae terminales, elongatae, paniculiformes, dense ramosae, infra foliatae, rufo-tomentosae, bracteolatae, dense multiflorae, 20–30 cm. longae, 10–15 cm. diam.; bracteae parvae, lineari-oblongae, utrinque acuminatae acutae, utrinque tomentosae, mox deciduae. Flores minores, pedicellati; calyx cupuliformis, regulariter obtuseque 5-dentatus, extus rufo-tomentellus, glandulis 2–4 parvis vestitus, intus glaber, 0.3–0.4 cm. longus et diam., fructifer subaccrescens; corolla minor, inaequaliter 5-lobata, subbilabiata, utrinque pubescens, statu sicco ca. 1.5 cm. longa, tubo inferne angustato in faucem ventricosam ampliato, intus ad insertionem staminum longe hirsuto, superne glabrato, calyce multo longiore, 0.7–1 cm. longo; stamina 4, didynamia, vix exserta, statu sicco 0.5–1 cm. longa, filamentis glabris; ovarium subglobosum vel obovoideum, apice subtruncatum, glaberrimum; stylus filiformis, teres, sparse pilosus, vix exsertus,

statu sicco ca. 1 cm. longus. Drupa minora, ovoideo-globosa, nitida, maturitate nigra, statu sicco 1.2–1.5 cm. diam.; calyx fructifer leviter excrescens, subapplanatus vel marginibus reflexis, quinatus, 0.5–0.7 cm. diam.

Ysabel Island: Tiratoña, alt. 600 m., *Brass* 3309, Dec. 8, 1932. — Vernacular name "Koko."

This plant is intermediate between *G. moluccana* (Bl.) Backer and *G. macrophylla* (R. Br.) Benth. and may be a hybrid of these species. From *G. moluccana* it differs in the tomentose under side of the leaves and the villous calyx; from *G. macrophylla* in the terete branches, the elevated nerves and veins on the upper side of leaves, somewhat in the form of panicles, but especially in the small and regular 5-toothed calyx.

Petraeovitex multiflora (Sm.) Merr. var. **salomonensis** Bakhuizen, var. nova.

Frutex scandens, gracilis; ramuli quadrangulares, primum tomentelli, glabrescentes. Folia opposita, ternata vel inaequaliter biternata; foliola 3–9, minora, sessilia, chartacea; foliola lateralia ovato-oblonga vel oblongo-elliptica, basi rotundata, apice obtuse acuminata, 1–4.5 cm. longa, 0.5–2.3 cm. lata, foliolum terminale oblongo-lanceolatum, utrinque attenuatum, basi decurrens, acute acuminatum, apice obtusiuscule acuminatum, 3.5–6 cm. longa, 1.5–2.5 cm. lata, omnia margine integra, supra glabra, subtus primo farinaceo-tomentosa, denique glabrescentia vel costa nervisque excepta glabra, nervis lateralibus 6–8 cum venis reticulatis utrinque prominulis; petiolus communis 2–3 cm. longus, petiolus lateralis 0.5–1 cm. longus, omnes superne canaliculati, cinereo-tomentelli. Inflorescentiae terminales, laxe paniculiformes, infra foliatae, multiflorae, 30–50 cm. longae, 20–40 cm. diam.; bracteae minutae lineares, tomentellae, 0.15–0.25 cm. longae; cymulae breviter pedunculatae vel superne subsessiles, 7–15-florae, tomentellae, 0.5–1 cm. diam., pedunculis 0–1 cm. longis. Flores parvi, subsessiles, albidi; calyx 5-dentatus, cinereo-tomentellus, 0.1–0.15 cm. diam.; corolla alba, extus minute pubescens vel glabrescens, in fauce albido-puberula, 5-lobata, lobis inaequalibus, reflexis; stamina 4, exserta, fauci inserta, glabra; stylus gracilis, exsertus, glaber, 0.3 cm. longus, stigmatibus bifidis; ovarium ovoideum, basi glabrum, apice cinereo-tomentellum.

Bougainville Island: Kupei Gold Field, alt. 850 m., *Kajewski* 1686, April 11, 1930.

This variety much resembles *P. sumatrana* H. J. Lam, but it has sessile leaflets, a cinereous-tomentose calyx and a hairy ovary.

Premna integrifolia Linnaeus, Mant. **2**: 252 (1771) s. l.

Bougainville Island: Kieta, sea level, *Kajewski* 1566, March 30, 1930; Kugu-maru, Buin, alt. 150 m., *Kajewski* 1842. Malaita Island: Quoimonapu, alt. 50 m., *Kajewski* 2330, Dec. 10, 1930. Guadalcanal Island: Vulolo, Tutuve Mt., alt. 1200 m., *Kajewski* 2503, April 14, 1931. San Cristoval Island: Waimamura, alt. 200 m., *Brass* 2624, August 10, 1932 (f. *taitensis* Schau.); Kirakira, *Brass* 2768, August 30, 1932; Star Harbour, *Brass* 3132, Oct. 1932. — Vernacular names "Garlu" (under no. 1842), "Qua-eu" (under no. 2330) and "Arru-arru" (under no. 2503).

Teysmanniodendron Ahernianum (Merr.) Bakhuizen, comb. nov.

Vitex Aherniana Merrill in Bur. Gov. Lab. Bull. **6**: 18 (1903).

A large sized tree, up to 50 m. high; bark grey or brown; wood hard, brown; branchlets round, greyish, rufous-pubescent, glabrescent. Leaves 2–3-foliolate, short petioled; petiole terete, rufous-tomentose, especially at the base and in the insertion of the petiolules, 4–5 cm. long; petiolules in all leaves equal, furrowed above, thickened and rufous-tomentose at the base only, otherwise glabrous, 2–4 cm. long. Leaflets oblong, coriaceous, rather rigid, shining above, glabrous on both surfaces, except pubescent on the midrib beneath when young, 10–32 by 4–13 cm., reticulations of leaves very dense beneath. Cymes axillary, many-flowered, 15–30 cm. long; peduncles 1–2 in the axils, flattened, rufous-tomentose, 5–12 cm. long. Flowers rather small; calyx funnel-shaped, obscurely 5-dentate, rufous-sericeous, 0.4–0.5 cm. long, and wide; corolla with very short tube, glabrous at the base, otherwise sericeous, throat and base of the lip densely villous; ovary globose, glabrous, biloculate. Fruit oblong or pear-shaped, purple green when ripe, shining and striate when dry, 1.5–2 cm. long, 1–1.5 cm. diam., one-seeded; exocarp coriaceous, thin; seed oblong, 1 cm. long, 0.5–0.7 cm. diam.; fruiting calyx enlarged, cup-shaped, truncate, 0.5 cm. long, 0.5–0.8 cm. in diam.

Ysabel Island: Tataba, alt. 50 m. *Brass* 3441, Jan. 5, 1933. Guadalcanal Island: Sorvorhio Basin, alt. 200 m., *Kajewski* 2715, Feb. 3, 1932. — Vernacular name "Seupa" (under no. 2715).

Vitex cofassus Reinwardt ex Blume, Bijdr. Flor. Ned. Ind. 813 (1826).

Bougainville Island: Kieta, sea level, *Kajewski* 1533, March 17, 1930; Kugu-maru, Buin, alt. 150 m., *Kajewski* 1843, May 28, 1930. Malaita Island: Quoimonapu, alt. 300 m., *Kajewski* 2381, Dec. 16, 1930. Guadalcanal Island: Berande River, *Kajewski* 2387, Dec. 24, 1930; Mamassa, Konga, alt. 400 m., *Kajewski* 2489, Feb. 13, 1931; Vulolo, Tutuve Mt., alt. 1200 m., *Kajewski* 2605, May 1, 1931. San Cristoval Island: Balego-

Diospyros insularis Bakh.

Diospyros insularis Bakh.

Diospyros samoënsis A. Gray

Nagonago, alt. 350 m., *Brass* 2821, Sept. 5, 1932. Ysabel Island: Maringe, *Brass* 3154, Nov. 19, 1932; Tasia, *Brass* 3272, Dec. 5, 1932. — Vernacular names "Moi-kewie" (under no. 1843), "Father" (under no. 2381), "Vada" (under no. 2387), "Vatha" (under no. 2489), "Vasa" (under no. 2605), "Hada" (under no. 2821), "Wara" (under no. 3154) and "Varha" (under no. 3272).

EXPLANATION OF PLATES

Plate 120

Diospyros insularis Bakh. (type G. Peekel 4 A from New Ireland, ♂). — A. Flowering branch (× ½). — B and C. Leaf base seen from above and from below (× 1½). — D. Inflorescence, flowers dropped (×2). — E–L. Male flowers with details: E–F. flowers from the inside and the outside (×2½); G. longitudinal section of flower, seen from the inside (× 2½); H. calyx, seen from the inside (× 2½); I. rudimentary ovary (× 10); K. androeceum (× 3½); L. stamens (× 5).

Plate 121

Diospyros insularis Bakh. (type Brass 3166 from the Solomon Islands, ♀). — A. Leafy branch (× ½). — B. Fruiting branch (× ½). — C. Axis of the fruiting branch (× 2½). — D. Peduncle of fruit at the apex (× 1½). — E–F. Fruiting calyx (× ½): E. from the inside; F. from the outside. — G–H. Seeds (× 1½): H. seed in transverse section.

Plate 122

Diospyros samoënsis A. Gray — A–B. Flowering branches of male plant (× ½). — C–F. Male flower bud with details: C. corolla bud (× 3); D. corolla bud cut lengthwise (× 3); E. stamens (× 5); F. anthers (× 10). — G. Flowering branch of female plant (× ½). — H–N. Female flower with details: H. flower buds from above and from below (× 2); I. calyx (× 2) and calyx-lobe, seen from the inside (× 2½); J. corolla bud (× 3); K. corolla bud cut lengthwise (× 3); L. ovary (× 3); M. anthers (× 15); N. ovary in transverse section (× 5). — R. Fruiting branch (× ½). — S–T. Fruiting calyx from the outside and from the inside (× 1); T. lobe of fruiting calyx from the outside (× 1½). — U. Seeds (× 1½). — V. Seed in cross section (× 2).

Botanic Gardens, Buitenzorg.

January 25, 1934.

AN ENDEMIC SOPHORA FROM RUMANIA

EDGAR ANDERSON

With plates 123 and 124 and one text figure

ONE of the most interesting endemics of the Balkan peninsula is the *Sophora* discovered at Babadag by J. Prodan.[1] Through the kindness of Dr. C. Georgescu of the Şcoală Politechnică at Bucarest I was able to visit this locality on September 4, 1934 and collected abundant fruiting material. Subsequent comparison with Asiatic material of *Sophora alopecuroides* L. in the herbaria of the Royal Botanic Garden at Kew and of the Arnold Arboretum has convinced me that the Rumanian plant deserves to be described as a distinct species and I take pleasure in naming it after its discoverer.

Sophora Prodanii, sp. nov.

Herba suffruticosa, 5–7 dm. alta. Folia 5–10 cm. longa, imparipinnata; foliola 19–25, oblongo-elliptica, 12 mm. longa, 7 mm. lata, membranacea, supra glabra, subtus pilos sparsos appressos gerentia. Racemus densus. Flores ignoti, non visi. Legumen 5–7 cm. longum, glabrescens; semina 3–7, luteo-fusca, 5 mm. longa.

Known only from a single hilltop near Babadag, Rumania.

Şeremet, Babadag, Rumania, *Edgar Anderson* no. 85 (type), Sept. 4, 1934 (specimens deposited in the herbaria of the Arnold Arboretum, Royal Botanic Garden Kew and British Museum of Natural History).

An erect suffrutescent herb from an underground rootstalk; stems, erect, 5–7 dm. tall, slender, with ascending simple branches, subterete, dark green with fine, rather scattered, short, appressed hairs. Leaves alternate, imparipinnate, 5–10 cm. long; stipules wanting; leaflets 19–25, elliptic oblong to oblanceolate, up to 12 mm. long and 7 mm. wide when well developed, dark green, rather thin, becoming brittle when dry; apex rounded with a mucronate tip. Leaflets glabrous above, pubescent below with very scattered fine short appressed hairs; margin entire and somewhat revolute; midrib evident but veins weak and evident only beneath; petiolule about 1 mm. long. Inflorescence terminal, racemose, dense, sub-erect. Flowers not seen. Fruit terete, torose, wingless, indistinctly ribbed, indehiscent or tardily dehiscent,

[1] Mag. Bot. Lapok. 11: 231, 235 (1912).

with sparse appressed hairs; pedicels in fruit 2–4 mm. long, strictly ascending. Seeds yellowish brown, 5 mm. long.

The species is of very restricted distribution. It is at present known only from this one locality, the summit of a small hill near the ancient town of Babadag. It occurs over a space of several acres in the edge of the forest and persists as a weed in an adjoining field. Prodan (loc. cit.) in his account of the plant from Babadag identified it with *S. alopecuroides* L. but pointed out that it was much more nearly glabrous.

Fig. 1. Distribution of Sophora alopecuroides and its Close Relatives

◎ = *Sophora Prodanii*
• = *S. alopecuroides*
○ = *S. alopecuroides* var. *tomentosa*
✤ = Intermediate form collected by Gilliat Smith

Sophora alopecuroides, sensu latiore, is a wide-spread species (see Fig. 1), extending from central Asia to northern Asia Minor and the vicinity of Constantinople (Istambul). From central Asia to Asia Minor there is a progressive transition in pubescence, leaf size, and leaf texture. If only the two ends of the series existed they could easily be maintained as two separate species, a small-leaved species with appressed silky hairs from northern Asia Minor and a coarser species with spreading tomen-

tose pubescence from Central Asia. As early as 1850 Spach[1] had proposed the name *S. Jauberti* for the *Sophora* from Asia Minor and in 1894 Freyn and Sintenis[2] described *Goebelia reticulata* from northern Asia Minor, a name which was later transferred to *Sophora* by Hayek.[3] Aznavour[4] went so far as to advance the plants collected by him in the suburbs of Constantinople to the status of a variety, *Buxbaumii* of *Goebelia reticulata.*

It is certainly true that there is marked geographical differentiation in *S. alopecuroides,* sensu latiore, but when a large series of specimens is examined, these local and regional differences are found to intergrade. Particularly interesting are two collections made by Mr. B. Gilliat Smith (nos. 1904 and 1714) in the neighborhood of Tabriz, Persia, which can be assigned with certainty neither to the form from Central Asia nor to that from Asia Minor. Since Tabriz is in the region where these two forms come together, it seems best to follow Boissier[5] and Bornmüller[6] and treat the *Sophora* from Asia Minor as *S. alopecuroides* L. and that from Central Asia as *S. alopecuroides* L. var. *tomentosa* (Boiss.) Bornm. Further study will undoubtedly permit the separation of other geographical varieties. The specimens I have seen from N. W. China which have been referred to *S. alopecuroides* are certainly different from those collected in Afghanistan and Persia.

Taken as a whole, *S. alopecuroides* and *S. Prodanii* present a graded series in size and texture of leaflet, pubescence and color (Table I).

TABLE I. COMPARISON OF LEAF CHARACTERS

	S. Prodanii	*S. alopecuroides*	*S. alopecuroides* var. *tomentosa*
leaf texture	brittle when dry	tenuous	coriaceous
upper side of leaflets	glabrous	appressed silky pubescence	tomentose pubescence
under side of leaflets	scattered appressed hairs	appressed silky pubescence	spreading tomentose pubescence
color	dark green	greenish gray	yellowish green
size of leaflets	7 × 12 mm.	8 × 16 mm.	9 × 24 mm.

[1]Illustr. Plant. Orientalium, 4: 45, t. 330 (1850–1853).
[2]Oest. Bot. Zeit. 44: 66, 98 (1894).
[3]Prod. Fl. Pen. Balcan. 1: 770 in Fedde, Rep. Spec. Nov. Reg. Veg. Beih. 30: 770 (1926).
[4]Magyar Bot. Lapok, 12: 163 (1913).
[5]Fl. Or. 2: 628–629 (1872).
[6]Bot. Cent. Beih. 27: 347 (1910).

There is no more difference, if as much, between *S. Prodanii* and *S. alopecuroides* from the neighborhood of the Bosphorus as between *S. alopecuroides* from Asia Minor and *S. alopecuroides* var. *tomentosa* from Afghanistan. But in the latter case, there is a full set of intermediate forms from the intervening territory while in the former the intermediates which once undoubtedly existed have long since disappeared. In the 250 miles between Babadag and the Bosphorus no sophoras of this group have been collected. The differences between *S. alopecuroides* and *S. Prodanii*, though slight, include leaf texture and color as well as pubescence and general size. For this reason *S. Prodanii* is put forward as a distinct species rather than as a variety of *S. alopecuroides*.

Sophora Prodanii undoubtedly originated as a semi-glabrous variety on the westward edge of *S. alopecuroides*. A large number of Balkan species represent westward extensions of Asiatic species, or find their closest relatives in the Asiatic flora. "It is necessary to bear in mind . . . that the Hungarian and Roumanian plains were covered with the waters of the Sarmatic and Pontic seas and lakes until relatively recent geological times (and) that the Bosphorus is no wider than a broad river . . . It follows . . . that migration on a wide front between the lowlands of the Balkan Peninsula and those of the north has been possible for land plants only since the end of the Tertiary period and must for the most part have been in one direction—northwards—as the Sarmatic and Pontic waters dried up; that migration along the northern part of Asia Minor into the Balkan Peninsula is geographically feasible and has been even more so in past geological periods."[1]

The persistence of *S. Prodanii* in this one isolated station in the Dobrudja is to be explained by the geological history of the Babadag mountains. These low mountains (or hills) are of very great age and though low in elevation have persisted for a long time as a land mass, remaining above the waters of the Sarmatic and Pontic seas and lakes. "It is safe to assume that they formed a refuge for relatively old types of plants and to this fact is due the richness of the Dobrudja in Tertiary relicts." (Turrill. loc. cit.)

To the question as to whether *S. Prodanii* evolved its distinctive characteristics before or after its separation from the sophoras of Asia Minor, the present day differentiation within the latter suggests an answer. Not only is there a progressive reduction westwards in size and pubescence from Central Asia to the Bosphorus but the same tendency can be seen within Asia Minor itself. The specimens of *S. alopecuroides* which most closely resemble *S. Prodanii* are from northwestern Asia Minor. These

[1]Turrill, W. B. The Plant Life of the Balkan Pen. Oxford. 1929.

facts suggest that in Miocene times *S. Prodanii* was already a well marked variety of *S. alopecuroides*. The Sarmatic and Pontic waters (Upper Miocene or Pliocene) destroyed the intervening intermediates and reduced *S. Prodanii* to a dwindling remnant in the Babadag Mountains. Within the immediate past at any rate, it has been so reduced in numbers as to undergo severe inbreeding and further divergencies from the parental type would be expected to have accumulated through the random effects of inbreeding on a small population.

Most of the plants at Babadag seemed to be infected with some gall-producing organism. The characteristic "witches brooms" produced in this way are very conspicuous in the photograph of the type specimen. Similar growths are apparently common in *Sophora alopecuroides*. Dr. W. B. Turrill has very kindly supplied me with the following list of specimens in the Kew Herbarium which exhibit the phenomenon: Nestorian Mountains and Gawan, *Capt. Garden* in 1857; Caucasus, *Prescot* in 1828; Near Tabriz, Persia, *Gilliat-Smith* in 1926; Pamir and Thian Shan Journey, *H. Appleton 190* in 1906.

In Babadag, the seeds of *S. Prodanii* were reported to be extremely poisonous. While *S. alopecuroides* has never been listed as poisonous so far as I know, there are a number of references to the poisonous seeds of other species of *Sophora*. The seeds of *S. secundiflora* Lag. are used by Mexican Indians as an intoxicant; one seed is said to be sufficient to kill a man and a half a seed produces a stupor lasting two to three days.[1] *S. flavescens* Ait. contains poisons which are made use of as insecticides.[2] The seeds of *S. tomentosa* L. yield a poisonous alkaloid. They are a common native remedy in the Philippines for stomach disorders.[3]

EXPLANATION OF THE PLATES

PLATE 123

Sophora Prodanii E. Anderson. Type specimen.

PLATE 124

A. Leaflet of *Sophora alopecuroides* var. *tomentosa* (× 7). From Stapf, s. n., collected at Schiraz, Persia, Aug. 23, 1885.
B. Leaflet of *Sophora Prodanii* (× 7). From Anderson, no. 85 (type).

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HARVARD UNIVERSITY.

[1]Kew Bull. 1892: 216–217; 1896: 231.
[2]Am. Jour. Pharm. 91: 104 (1919).
[3]Contrib. U. S. Nat. Herb. 9: 376 (1905).

SOPHORA PRODANII E. Anders.

A. Leaflet of Sophora alopecuroides var. tomentosa (Boiss.) Bornm.
B. Leaflet of Sophora Prodanii E. Anders.

SUPPLEMENT TO THE SPONTANEOUS FLORA OF THE ARNOLD ARBORETUM

Ernest J. Palmer

Since the publication in 1930 of the list of plants growing spontaneously in the Arboretum[1] observation and collecting has been continued, and as a result so many additions have been made to the flora that it now seems desirable to publish a supplementary list.

In 1931 I had an opportunity for the first time to remain at the Arboretum throughout the spring months and to make a thorough exploration of the native and introduced plants at that season. As a result of this and of subsequent investigation a large number of plants not recorded in the first list have been found and additional information about some of the rarer species previously recorded has also been secured.

Of the 173 new species and varieties reported in this supplement 94, or nearly 55 percent, are plants native in the Boston area and presumably in the Arboretum, and the remaining 79, or 45 percent, are introduced. Seven plant families and 43 genera are added to the spontaneous flora in this supplementary list.

The grasses, sedges, and composites, as might be expected, furnish the largest number of additions. The really surprising thing about the present list is the relatively large number of native plants that have been found. Many of these are now quite scarce or rare in the Arboretum. Several of the introduced plants are probably recent introductions. Amongst the more interesting discoveries are: *Polystichum acrostichoides, Aristida dichotoma, A. gracilis, Carex communis, C. Goodenowii, C. longirostris, Erythronium americanum, Luzula nemorosa, Cypripedium acaule, ×Quercus Rehderi, Anemone quinquefolia, Potentilla canadensis* var. *villosissima, Polygala sanguinea, Lechea intermedia, L. tenuifolia, Viola pedata* var. *linariloba, V. sagittata, Pyrola americana, Trientalis americana, Epifagus virginiana, Houstonia caerulea, Liatris scariosa, Aster acuminatus, Helenium nudiflorum, Senecio aureus, Hypochaeris radicata, Sonchus arvensis* var. *glabrescens, Hieracium florentinum,* and *H. vulgatum.*

A single weak plant of the Christmas fern was discovered in 1931 by Dr. Grant D. Darker on a wooded slope of the North Woods, where it had probably survived from a native colony. Later, sev-

[1] Jour. Arnold Arb. 11: 63–119 (1930).

eral plants were found on the north side of Hemlock Hill. At a little lower level in the latter locality a small group of the stemless lady's slipper was found growing under the hemlock and pine trees. The star flower is also found here, as well as on the top of the hill and as a greater rarity along the base of a gravelly ridge in the North Woods. The little bluets or innocence grows sparingly among the laurels and other shrubs at the foot of the hill, and a little higher up is found the round-leaved wintergreen. As the hemlock grove on this rocky elevation is probably the only bit of practically virgin timber left in the Arboretum and as the native flora has been little disturbed even in a few spots along the base of the hill where there is an accumulation of richer soil, a number of interesting plants have been able to survive here that at present are not found elsewhere.

The March lily has not yet been seen flowering in the Arboretum, but a small colony of sterile plants comes up each year in a moist shady spot on the south side of Hemlock Hill. The plants apparently lack sufficient vitality to produce blossoms, probably due to the increased shade. A colony of plants blooming freely is found just outside the Arboretum area on a wooded bank in the grounds of the Adams Nervine Hospital, and only a few yards from the division fence. The wood anemone survives sparingly at the base of wooded hills and even on open banks that were cleared of native trees only in recent years. It has been found at the edge of the North Woods, on the slopes of Bussey Hill in the oak group, along a bank of Bussey Brook below the junipers, and in the South Woods near Peters Hill. The purple milkwort grows on an open grassy bank on the east side of Peters Hill, and near the same spot a single plant of the bird-foot violet was found. Several plants of the latter were also found in open rocky woods on the top of Hemlock Hill, but they are likely soon to be exterminated by careless picking and trampling. A specimen of the beech-drops was collected on the south side of Hemlock Hill, but it has not been observed elsewhere in the Arboretum. The hairy bush-clover and the pinweed (*Lechea tenuifolia*) grow together in dry gravelly or rocky soil at the edge of the Central Woods, on the north slope of Bussey Hill, and near a small abandoned quarry in the South Woods. *Lechea intermedia* is also found near the top of Peters Hill.

Amongst the native woody plants that have been added to the list the low juniper is one of the rarest. Two or three small plants of this are growing on conglomerate outcrops in the Central Woods, where they are probably indigenous. The scrub chestnut oak grows sparingly near the same spot as well as on top of Hemlock Hill, where a single plant was seen. At this locality in the Central Woods was also found the inter-

esting natural hybrid between the bear oak and the black oak (*Quercus Rehderi*) growing with both of the parent species. The choke berry is another native shrub found in the Central Woods and a few plants of it have survived the repeated mowings of the grass on the northeast slope of Peters Hill. The spice-bush and high-bush blueberry grow in lower and richer ground at a few places on the borders of the woods.

It is gratifying to find evidence that a second species of thorn was native in the Arboretum. Specimens of *Crataegus rotundifolia* collected many years ago by Mr. C. E. Faxon and others in Bussey Wood and on Peters Hill were found in the herbarium, and sprouts of this species were found to be still growing at the latter locality. Mr. Faxon also collected specimens of the native blackberries and other plants in the Arboretum, some of which are preserved in this herbarium and others at the Gray Herbarium or in that of the New England Botanical Club.

It is interesting to note the introduction of new plants appearing spontaneously in the Arboretum and how they succeed and spread or fail to establish themselves and disappear after a single season or in a few years. Before the publication of the original list a few leaves of what appeared to be a sterile plant of *Senecio aureus* were seen between the Linden group and the bridle path. In 1931 a vigorous colony came up here and bloomed freely, making a conspicuous show. The following year only two or three plants remained and a search during the past summer failed to reveal any trace of it. A few plants of this species have also been found in the poplar group near Peters Hill. The king devil (*Hieracium florentinum*) has also recently appeared there, but in greater abundance farther up on the slopes of the hill among the thorns. This year it was also noted in the Celtis group near the North Woods. Fool's parsley has become more common at two localities, at the foot of the hills near the Leitneria group and along the base of Bussey bank near the Forsythia planting. A vigorous plant of the blue weed came up along the bridle path opposite the Horsechestnut group last year. It was blooming freely when cut down by the mowers, but this year no trace of it could be found. Two weedy grasses, *Eleusine indica* (the goose grass) and *Eragrostis cilianensis* have recently appeared on dumps and in waste ground at the old quarry along Bussey Street, and the latter also in the South Street nursery. The flower-of-an-hour, Japanese knotweed, four-o-clock, *Cyperus esculentus* and other cultivated and weedy things have also turned up here, and this and the South Street tract continue to be the chief sources for plants of this class. At the latter place, where a considerable tract of low fertile land surrounding the pond is still unoccupied and grown up with weeds, a real plant succession has been taking place. A number of plants that appeared

here soon after the construction of the pond have already been crowded out by the more aggressive weeds but other immigrants arrive from time to time. Last year *Boltonia asteroides* and *Galium asprellum* were noted here for the first time, and the latter at least has become more abundant. Last year a large colony of the smooth form of the perennial sow-thistle made a conspicuous show with its large yellow flowers. The yellow Canada lily also sent up a number of tall spikes above the other weeds at one side of the tract. On and about the rubbish dumps here several other weeds as well as escapes from cultivation have appeared. Amongst them are the gourd and jimson weed, as well as another species of thorn-apple, *Datura Metel.*

A number of herbaceous plants, as well as a few shrubs and trees, persist in the Arboretum from the old gardens formerly planted here, and some of these appear to be holding their own or increasing in number. The Virginia spiderwort and ox-eye have spread into the meadow near the old Dawson House, and Scilla, tulips and crocuses of various colors spring up in the grass each year making a pretty display. A bank near the barn of the State Laboratory is also carpeted with the brilliant blue of the Scilla blossoms in spring, and it is found more sparingly in other localities. The star of Bethlehem, day lily, narcissus and European bellflower are all well established in different parts of the Arboretum. More restricted are the white-flowered form of *Campanula persicifolia,* which is growing along the lilac border and in the open ground on the east side of Bussey Hill, and the English violet, abundant but local along a bank near the Jamaica Plain gate. A few plants of a small perennial pea (*Lathyrus pannonicus* var. *versicolor*) come up and bloom each year on the east side of Bussey Hill below the Overlook, and *Corydalis bulbosa* is growing near the top of the bank below the Bussey greenhouses, where Dr. Edgar Anderson reports having seen it at least ten or twelve years ago.

Several plants reported in the first list have already disappeared from the Arboretum, or at least have not been seen again. Most of these were waifs escaped from cultivation, such as the cock's-comb, candytuft, sweet alyssum, beef-steak plant, sneeze weed, corn flower and *Nicotiana,* or weeds of chance introduction, such as the jointweed, small bindweed and *Bassia,* but amongst them are also the cardinal flower, blue lobelia, wild senna, beard-tongue and Venus' looking-glass. It is quite possible that some of these will be introduced again at some time. The European smoke-tree, mentioned as having formerly been seen on Hemlock Hill, has been rediscovered growing there amongst the rocks, and a specimen of the moth mullen was collected during the present summer among the lilacs at the foot of Bussey Hill. Hepatica has been reintroduced at

the place where it formerly grew near the edge of the North Woods. A few plants of both *Hepatica americana* and of *H. acutiloba* have been set out and it is hoped they will survive. It is probable that it was the latter species that was formerly native here and not *H. americana* as reported on the list.

The presence of certain native plants persisting in places scarcely suitable to them at present offers some evidence as to former conditions in parts of the Arboretum and of the changes that have taken place, and this may have some value as a guide or check in future planting, since it affords a clue to both past and present soil and drainage conditions. Skunk cabbage continues to come up every year along what appears to be now a well-drained bank below the stone foot bridge over Bussey Brook and near the bald cypresses, as well as along the bridle path opposite the lindens, among the Chinese apples near Peters Hill, and at several other places. Sensitive fern, royal fern, and the lance-leaved violet coming up in the edge of the maple group, at the foot of the hills near the Ilex and Aesculus groups, along the Meadow Road by the laurels, and elsewhere, indicate former boggy areas and show that the water table even now is very near the surface in wet seasons. Along the edge of the path near a planting of *Aesculus parviflora* the water pennywort has even managed to survive and still sometimes to produce fruit. The persistence also of certain shade-loving plants in open sunny situations where they are gradually being exterminated furnishes evidence, in some case no longer available from records, that the protecting woods have not long been removed.

As the Arboretum has developed, the natural drainage has been modified or changed in many places. A brook formerly entered the Arboretum area from the west through a gap in the low hills near the Aesculus and Linden groups. A small tributary which drained the ponds near the Forest Hills gate joined it as it flowed across the level ground at the foot of the hills and into the low ground across the Meadow road. The water from this brook is now carried under ground and only a small fragment of the course of the smaller stream can be made out in the somewhat boggy area where the corkwood is now growing. The course of these streams is shown on old maps and their history helps to account for the presence here of such native plants as *Carex crinita, Scirpus rubrotinctus, Pilea pumila, Callitriche palustris, Ludvigia palustris, Hypericum majus, Hydrocotyle americana* and *Scutellaria lateriflora,* as well as suggesting the great changes that must have taken place in the character of the flora and the many plants that must have disappeared from the area since the time when these brooks flowed across the fields and into the low meadow and bog.

The course of Bussey Brook has also been diverted or straightened at several points, and the amount of water that it formerly received from seepage and springs has been greatly diminished by the clearing off or thinning of the forests on the hills and of thickets along its margins, the water now running off rapidly after a rain instead of sinking into the humus and soil. The diversion of its permanent water supply has also been made almost complete by the construction of ditches and sewers along its upper course beyond the Arboretum. It is evident from a study of the surviving native plants as well as from the topography that a small swamp or bog formerly occupied the low ground a little way above the stone foot bridge and between the base of Hemlock Hill and the slopes now occupied by the conifer groups. A spring and little rivulet carrying water except in the dryest seasons still feed the brook on the north side, and small areas are kept wet by seepage water here for a considerable part of the year. But even beyond these moist places some traces of the palustral flora still remain. Such plants as *Onoclea sensibilis, Lycopodium complanatum* var. *flabelliforme, Carex lurida,* and sprouts of *Salix pedicellaris, Alnus incana, Vaccinium corymbosum* and of an undetermined species of *Rhododendron* have been found here. On similar evidence it can be seen that certain parts of Bussey Hill and of Peters Hill were covered with forest until recent years. An early map of the Arboretum shows native woods extending over a large part of Bussey Hill, and Bussey Woods is mentioned on some of Mr. Faxon's plant labels, but I have seen no similar record in regard to Peters Hill. This hill was probably at one time covered with forest, but from the present composition of the flora it may be inferred that much of the surface was cleared and used for pasture or other purposes at an early day, but that remnants of the forest remained along the east and north sides until quite recently. Sprouts of a number of characteristic forest trees and shrubs continue to come up here in spite of annual mowing, and stumps of several large trees are still in evidence. A single large white oak survives on the east slope and in its protection a number of plants are growing that are not found in the open ground. Others still huddle rather pathetically about the decaying stumps or in the meager shade afforded by the small thorn trees. Several groups of sprouts of the trembling aspen and of the large-toothed aspen are found on the hillsides as well as scattered specimens of various species of oak, hickory, chestnut, birch, elm, wild-cherry and ash; and among shrubs are the bayberry, sweet fern, meadowsweet, dwarf juneberry (*Amelanchier oblongifolia*), choke-cherry, sheep laurel, panicled dogwood and several species of wild rose, blackberry, dewberry, raspberry and blueberry. A few depauperate plants of the ground pine still survive in one spot, and

a large colony of false Solomon's seal (*Smilacina stellata*) is growing about one of the old stumps, with the wood aster, false lily of the valley and other plants that are evident relics of a woodland flora. The complete removal of the forest or thickets on rather steep slopes has resulted in the loss of the humus and in the leaching out and removal of the soil, which is reflected in the slow growth and poor condition of some of the Crataegus trees on this side of the hill.

The original native flora has almost entirely disappeared from most of the Arboretum, and increasing inroads upon such fragments of it as remain will necessarily be made as the planting of cultivated trees and shrubs continues and as they come to occupy the ground more fully, and as the surface and soil are further modified by drainage, grading, and the bringing in of outside soils and fertilizers. Such traces of it as still remain have considerable significance in a number of ways, and a record of it should be of increasing interest and value in the future. The introduction of weeds and other exotic plants from various sources is certain to continue, and specimens of them should be collected and records kept as they appear or are discovered, and it may be thought worth while to issue another supplement to the Spontaneous Flora at some time in the future.

I wish to express my thanks to the members of the staff and other friends who have shown an interest in the native and introduced plants of the Arboretum through the contribution of specimens and other assistance. Mr. Frederic W. Grigg has examined a number of the grasses, sedges, and other plants and has aided in their determination. I am also under obligation to Mr. C. A. Weatherby for assistance on points of nomenclature, and to Professor J. G. Jack and Professor Alfred Rehder of the Arboretum staff for information about early conditions in the Arboretum and for other suggestions, as well as to several others who have brought in specimens of plants found in the Arboretum.

ENUMERATION OF THE ADDITIONAL PLANTS COLLECTED[1]

Polystichum acrostichoides (Michx.) Schott. Christmas Fern. One plant found by Grant D. Darker on east slope of gravelly ridge, North Woods, probably surviving from a former native colony; also several plants on rocky wooded slopes on north side of Hemlock Hill. Nos. 40273, 42588. Rare.

Thelypteris spinulosa (O. F. Muell.) Nieuwland var. *intermedia* (Willd.) Nieuwland. Spinulose Shield Fern. Base of wooded hills, near Aesculus group. No. 39678.

[1]Introduced plants are marked by an asterisk (*).

Juniperus communis L. var. *depressa* Pursh. Low Juniper. Rocky ground, Central Woods. No. 36405. Rare.

Typha latifolia L. Common Cat-tail. Borders of ponds and brooks. No. 39605.

Sagittaria latifolia Willd. f. *gracilis* (Pursh) Robinson. Muddy margins of Pond, South Street tract. No. 40248.

Potamogeton epihydrus Raf. var. *Nuttallii* (Cham. & Schlecht.) Fernald. In shallow water along muddy margins of pond, South Street tract. No. 42723.

Panicum philadelphicum Bernh. Waste and cultivated ground, No. 39669. Uncommon.

Panicum dichotomiflorum Michx. Waste and cultivated ground. Nos. 38229, 39704.

Panicum depauperatum Muhl. var. *psilophyllum* Fernald. Rocky slopes and ledges. Nos. 25608, 25627.

Panicum linearifolium Scribn. Rocky ledges, conglomerate outcrops. No. 40172.

Panicum lanuginosum Ell. var. *Lindheimeri* (Nash) Fernald. (*P. Lindheimeri* Nash). Common in dry open woods and meadows. Nos. 39588, 39621, 39638, 42646.

Panicum lanuginosum var. *septentrionale* Fernald. Border of woods. No. 39635.

Panicum commutatum Schultes var. *Ashei* (Pearson) Fernald. Dry, open woods, South Street tract. No. 42675.

Panicum oligosanthes Schultes var. *Scribnerianum* (Nash) Fernald (*P. Scribnerianum* Nash). Dry gravelly banks between Shrub Collection and Arborway wall. Nos. 39627, 39694.

Panicum latifolium L. Edge of North Woods, near Celtis group. No. 39637. Rare.

**Echinochloa crusgalli* (L.) Beauv. f. *longiseta* (Trin.) Farwell. Cultivated and waste ground, with the typical form. No. 28102a.

Echinochloa muricata (Michx.) Fernald. Cultivated and waste ground. No. 42212.

Aristida dichotoma Michx. Poverty Grass. Sterile gravelly banks, between Shrub collection and Arborway wall, and also on conglomerate outcrops in Conifer group. Nos. 38190, 39742.

Aristida gracilis Ell. Sterile gravelly banks, between Shrub Collection and Arborway wall. No. 38191.

**Agrostis canina* L. Brown Bent Grass. Dry open ground, slopes of Bussey Hill. No. 39578.

**Eragrostis cilianensis* (All.) Link ex Lutati. (*E. megastachya* Link.)

Waste ground, old quarry near Bussey Street, and also as a weed in South Street nursery. Nos. 38197, 38227.

Eragrostis pectinacea (Michx.) Steud. Meadows and dry banks. Nos. 39687, 40234.

Glyceria septentrionalis Hitchc. Margins of Bussey Brook, near Conifer group. No. 39661.

Festuca ovina L. Sheep's Fescue. Gravelly slopes, south side of Peters Hill. Nos. 36461, 36506.

Festuca rubra L. var. *commutata* Gaud. Open ground, border of Aesculus group. No. 40199.

**Cyperus esculentus* L. Rich waste ground, old quarry along Bussey Street. No. 42202.

Scirpus rubrotinctus Fernald. Along little brook, near Aesculus group. No. 36586.

Carex Crawfordii Fernald. Open banks and meadows. No. 40162.

Carex tenera Dewey (*C. straminea* of Gray's Man.). Dry ground, borders of woods and meadows. Nos. 42609, 42624.

Carex laxiflora Lam. var. *gracillima* Boott. Moist banks of pond, near Forest Hills gate. No. 36501.

Carex laxiflora var. *leptonervia* Fernald. Shaded banks and borders of woods. Nos. 39589, 42650.

Carex canescens L. var. *disjuncta* Fernald. Springy ground, near base of Peters Hill. No. 36531.

**Carex caryophyllea* Lat. Dry slopes and gravelly banks, Peters Hill, Bussey bank, and near Dawson House. Nos. 36455, 40132, 40165.

Carex angustior Mackenzie. (*C. stellulata* Good. var. *angustata* Carey). Local in boggy ground about spring, along southeast side of Peters Hill. Nos. 36532, 40128; also a specimen collected by *Mary E. Gilbreath,* June 6, 1892, in herb. of New England Botanical Club.

Carex panicea L. Grassy slopes of Peters Hill, in Crataegus group. Nos. 36423, 36460, 36529, 36558.

Carex pennsylvanica Lam. var. *lucorum* (Willd.) Fernald. Rocky banks, near top of Hemlock Hill. No. 36578.

Carex varia Muhl. Dry rocky ledges, south side of Hemlock Hill, and along base of hills, North Woods. Nos. 40029, 40279a, 40281a.

Carex Goodenowii J. Gay. Wet ground about spring, southeast side of Peters Hill, and also in low meadows near Administration Building. Nos. 40129, 40159, 40177.

Carex communis Bailey. Specimen in the herbarium of the New England Botanical Club, collected by *C. E. Faxon,* May 30, 1878; also found on Hemlock Hill. No. 36455.

Carex brevior (Dewey) Mackenzie. Dry open woods, Oak group. No. 42621.

Carex longirostris Torr. Shaded ground, at foot of Hemlock Hill, on south side. No. 40276.

Carex crinita Lam. var. *gynandra* (Schwein.) Schwein. & Torr. Wet rocky ground along Bussey Brook at foot of Hemlock Hill. No. 42622. Rare.

Carex lupulina Muhl. Margin of small pond west side of Bussey Hill. Nos. 40188, 40205.

**Tradescantia virginiana* L. VIRGINIA SPIDERWORT. Freely escaped into meadow, near Dawson House. Nos. 39646, 39675.

**Luzula nemorosa* (Poll.) Mey. Open grassy border, near Dawson nursery. No. 40185.

Erythronium americanum Ker. YELLOW ADDER'S-TONGUE. Under trees at base of Hemlock Hill, on southeast side, where leaves come up each year from a small colony, but it has not been found flowering. There is also a colony which flowers freely on a wooded hillside of the Adams Nervine Hospital grounds, only about 20 feet from the Arboretum boundary, where the flowering specimen was collected. Nos. 36387, 36415.

Allium canadense L. WILD GARLIC. Open wooded banks, South Street tract. No. 42620.

**Scilla sibirica* Andr. Well established on banks near State Laboratory barn, and at top of Bussey Bank. No. 36361.

Sisyrinchium angustifolium Mill. Dry open slopes of Peters Hill, in Crataegus group and on slopes of Bussey Hill. Nos. 36497, 40026, 40144.

Cypripedium acaule Ait. STEMLESS LADY'S SLIPPER. Under hemlocks and pines, near the base of Hemlock Hill, on the northeast side. No. 40272.

Salix lucida Muhl. SHINING WILLOW. Along small spring brook, Conifer group. No. 39604.

Salix pedicellaris Pursh. BOG WILLOW. In boggy ground about spring, southeast side of Peters Hill, and margins of Bussey Brook near Conifer group. Nos. 36384, 36418.

Salix humilis Marsh. PRAIRIE WILLOW. Open slopes of Peters Hill, in Crataegus group. Sprouts coming up after repeated mowing. No. 39706.

**Salix alba* L. var. *calva* G. F. W. Mey. Wet ground about spring, Poplar group. No. 36530.

**Salix fragilis* L. CRACK WILLOW. Slopes of Peters Hill; sprouts persisting after mowing. No. 39718.

**Salix pyrifolia* Anders. Waste ground near pond, South Street tract. No. 40250.

Populus tremuloides Michx. QUAKING ASPEN. Several large colonies of sprouts persistent after repeated mowings, on Peters Hill, in Crataegus group. No. 36413.

Carya ovalis (Wang.) Sarg. BROOM HICKORY. North Woods. No. 39651a.

Quercus prinoides Willd. SCRUB CHESTNUT OAK. Rocky banks near top of Hemlock Hill and on conglomerate outcrops, Central Woods. Nos. 36456, 39692. Rare as a native plant.

Quercus Rehderi Trelease. (*Q. ilicifolia* × *velutina*). Rocky slope, Central Woods. No. 39682. Rare.

**Quercus Leana* Nutt. (*Q. imbricaria* × *velutina*). Rocky slope, Central Woods; also sprouts that appear to be this hybrid coming up spontaneously in Oak group. No. 39683.

Polygonum Careyi Olney. Waste ground and cultivated beds, near State Laboratory barn. Nos. 42689, 42708.

Polygonum lapathifolium L. Moist waste ground and borders of ponds. Nos. 42693, 42709.

Polygonum punctatum Ell. var. *leptostachyum* (Meisn.) Small. No. 42711.

**Polygonum Sieboldii* De Vriese. Waste ground, old quarry near Bussey Street. No. 42201.

**Rumex crispus* × *obtusifolius*. Margins of small spring brook, Conifer group. Growing with the parent species. No. 40202.

**Mirabilis Jalapa* L. FOUR-O-CLOCK. Waste ground, as a waif, old quarry near Bussey Street. No. 39703.

**Aristolochia Kaempferi* Willd. JAPANESE BIRTHWORT. Open ground near Administration Building, and also along Meadow Road near rock spring. No. 42673. *Aristolochia Clematitis* included in the original list, without collection, was probably based on young sprouts of this species, and should therefore be dropped.

**Spergula arvensis* L. CORN SPURRY. In cultivated ground among laurels and other shrubs, near Hemlock Hill. Nos. 38171, 38190.

**Sagina decumbens* (Ell.) T. & G. PEARLWORT. Grassy borders and waste ground, old quarry and along Valley Road. Nos. 42633, 42660.

**Silene antirrhina* L. SLEEPY CATCHFLY. Waste and cultivated ground, Maple group. No. 32635.

**Silene Armeria* L. SWEET WILLIAM CATCHFLY. Grassy borders, near Administration Building. No. 42688.

**Saponaria officinalis* L. BOUNCING BET. Meadows and waste ground, near Dawson nursery. No. 39684.

**Ranunculus bulbosus* L. BULBOUS BUTTERCUP. Common in meadows. Omitted through oversight from first list. Nos. 36438, 36526, 36587.

Anemone quinquefolia L. WOOD ANEMONE. Local in open woods, North Woods, slopes of Bussey Hill, near Oak group, and South Woods, near Peters Hill. Nos. 36372, 36398, 36410.

**Clematis paniculata* Thunb. Escaped into meadows, in Tilia group, No. 40182.

**Aquilegia vulgaris* L. GARDEN COLUMBINE. Bussey bank, in partial shade. No. 42607.

**Liriodendron Tulipifera* L. TULIP TREE. There is a large tree of this species in the edge of the woods along the base of Hemlock Hill that appears to be spontaneous.

**Berberis Thunbergii* DC. Established in woods near top of Peters Hill, and also on Hemlock Hill. No. 36380.

Benzoin aestivale (L.) Nees. SPICE BUSH. Near base of gravelly ridge, North Woods. No. 36437.

**Corydalis bulbosa* DC. Shaded bank, near Bussey Greenhouse. No. 40005.

**Rorippa sylvestris* (L.) Bess. YELLOW CRESS. Waste ground and cultivated borders. Nos. 39562, 39657.

**Diplotaxis muralis* (L.) DC. Waste ground about pond, rich soil, South Street tract. No. 38233.

**Ribes sativum* Syme (*R. vulgare* Lam.) RED CURRANT. Wooded bank near Forest Hills gate, also in woods near top of Peters Hill. Nos. 36394, 36412a.

**Gillenia trifoliata* (L.) Moench. INDIAN PHYSIC. Open woods, edge of Oak group. No. 36602. Rare.

Aronia arbutifolia (L.) Ell. CHOKEBERRY. Rocky open woods, Central Woods, and also on north slope of Peters Hill. No. 36404.

**Malus baccata* Borkh. var. *mandshurica* Schneider. Northeast side of Peters Hill. No. 40017.

**Malus hupehensis* (Pamp.) Rehder (*M. theifera* Rehder). Northeast slopes of Peters Hill. No. 40253.

Amelanchier stolonifera Wiegand. Open woods, top of Hemlock Hill. No. 40265.

Crataegus rotundifolia Moench. Bussey Woods, *C. E. Faxon*, June 6, 1882; *Geo. Engelmann*, Aug. 27, 1882; Peters Hill, *C. E. Faxon*, Oct. 1, 1883, Sept. 21, 1889; *J. G. Jack*, May 23, 1900. Sprouts of this plant still persist in the edge of the woods near the top of Peters Hill.

Rubus Idaeus L. var. *strigosus* (Michx.) Maxim. Northeast slope of Peters Hill, in Crataegus group. No. 39725.

**Rubus parvifolius* L. Escaped and well established in Quercus group. No. 40203.

Rubus Jeckylanus Blanchard. *C. E. Faxon,* June 7, 1913.

Rubus allegheniensis Porter. Open woods and banks. Nos. 36564, 40145.

Rubus flagellaris Willd. DEWBERRY. Common in open rocky woods and on conglomerate outcrops. *C. E. Faxon,* July 19, 1909. Nos. 36451, 37689.

Rubus Randii (Bailey) Rydb. *C. E. Faxon,* July 21, 1912; July 31, 1912; July 7, 1913.

Potentilla canadensis* var. *villosissima* Fernald. Cultivated ground. No. 28014. (See Rhodora, **33: 187. 1931).

**Prunus Cerasus* L. MORELLO CHERRY. Rocky woods on Hemlock Hill, and in woods near top of Peters Hill. No. 36493.

**Prunus pumila* L. var. *susquehanae* Jaeg. SAND CHERRY. Open woods, Hickory group, and persisting as sprouts after repeated mowing on Peters Hill. Nos. 36493, 40259.

**Colutea media* Willd. BLADDER SENNA. Open banks near Arborway wall and on Overlook. *W. H. Judd,* July, 1931.

**Amorpha fruticosa* L. FALSE INDIGO. Borders of pond, near Forest Hills gate. No. 38240.

Lespedeza hirta (L.) Hornem. HAIRY BUSH-CLOVER. Rocky banks and borders of woods, Central Woods, near chestnuts, slopes of Bussey Hill and South Woods. Nos. 39653, 39735.

**Medicago hispida* Gaertn. BUR CLOVER. Waste ground, old quarry near Bussey Street. No. 38201.

Apios americana Med. (*A. tuberosa* Moench). GROUND NUT. Open grassy slopes, in Malus group, near foot of Peters Hill.

**Lathyrus pannonicus* (Kramer) Garcke var. *versicolor* (Gmel.) Maly. Open bank near small pond, on slope of Bussey Hill. Nos. 39660, 40008.

Oxalis europaea Jord. f. *villicaulis* Wiegand. Cultivated and waste ground, with the typical form. No. 39748.

Oxalis stricta L. Rocky open ground, South Woods. No. 38211.

Polygala sanguinea L. PURPLE MILKWORT. Open slopes of Peters Hill, in Crataegus group. No. 39655.

Callitriche palustris L. Moist banks and borders of ponds and brooks. Further study of more mature specimens show that plants reported in original list as *Callitriche heterophylla* Pursh are this species, and the latter should therefore be dropped from the list.

**Evonymus obovatus* Nutt. TRAILING STRAWBERRY BUSH. Moist ground at base of hills, North Woods. No. 36569.

**Celastrus orbiculatus* Thunb. Rocky slopes, south side of Hemlock Hill. No. 42591.

**Ampelopsis humulifolia* Bunge. Dumps and waste ground. South Street tract. No. 42694.

**Hibiscus Trionum* L. FLOWER-OF-AN-HOUR. Waste ground, old quarry near Bussey Street. No. 38199.

**Malva parviflora* L. Waste ground, old quarry, near Bussey Street. No. 38200.

**Malva verticillata* L. var. *crispa* L. CURLED MALLOW. Waste ground, old quarry south side of Bussey Street. No. 42794.

**Sida hermaphrodita* (L.) Rusby. VIRGINIA MALLOW. Rocky open ground, near Centre Street gate. No. 25893. This was incorrectly identified in original list as *Napaea dioica* L., a plant which it closely resembles.

Lechea tenuifolia Michx. PINWEED. Dry gravelly banks and borders of woods, Central Woods and South Woods. Nos. 39653, 40216.

Lechea intermedia Leggett. Gravelly banks, near top of Peters Hill. No. 42701.

Viola pedata L. var. *linariloba* DC. BIRD-FOOT VIOLET. Rocky open woods, top of Hemlock Hill and a single plant found on east slope of Peters Hill. Nos. 36557, 40256.

Viola sororia Willd. Meadows, Aesculus group. No. 36477.

Viola latiuscula Greene. Common in meadows and on open banks. Nos. 36366, 36388.

Viola sagittata Ait. ARROW-LEAVED VIOLET. Moist grassy ground, near Arborway wall, in Maple group. Nos. 40268, 42670. Rare.

**Viola odorata* L. ENGLISH or SWEET VIOLET. Shaded bank, near Jamaica Plain gate. Nos. 36417, 39597, 40007.

Viola fimbriatula × *papilionacea*. Base of hills, near Leitneria group. No. 42682.

**Epilobium hirsutum* L. Low ground along brook, near Arborway wall and opposite Administration Building, *C. H. L. Gebfert*.

**Aralia hispida* Vent. BRISTLY SARSAPARILLA. Waste ground, old quarry along Bussey Street.

**Cornus stolonifera* Michx. RED OSIER. About small abandoned quarry, South Woods. Nos. 36513, 36524.

Pyrola americana Sweet. ROUND-LEAVED WINTERGREEN. Woods, north side of Hemlock Hill. Nos. 39565, 39591.

Vaccinium corymbosum L. HIGH BLUEBERRY. Open woods, Central Woods, slopes of Peters Hill, and along small brook near leitnerias. Nos. 39585, 39631, 40143.

Trientalis americana (Pers.) Pursh. Star Flower. Woods, top and north slopes of Hemlock Hill, and base of hills, North Woods. Nos. 36454, 40030, 40271.

**Ligustrum vulgare* L. Privet. Escaped in thickets and open woods. Peters Hill and South Woods. No. 38184.

**Syringa vulgaris* L. Common Lilac. Persistent and spreading from cultivation in several places. *J. G. Jack.*

**Phlox paniculata* L. Garden Phlox. Rich waste ground, South Street tract. Nos. 40242, 42676.

**Echium vulgare* L. Blue Weed. Weedy and grassy border along bridle path, near Aesculus group. Nos. 40183, 40236.

Lycopus rubellus Moench. Wet meadow, between Administration Building and Arborway wall. No. 39691.

**Physalis heterophylla* Nees var. *nyctaginea* (Dunal) Rydb. Rich open ground, South Street tract. No. 28149.

**Datura Stramonium* L. Jimson Weed. On dump, South Street tract. No. 38236.

**Datura Metel* L. Thorn Apple. On dump, South Street tract. No. 42208.

**Lycopersicon esculentum* Mill. Tomato. Not rare in waste and cultivated ground and sometimes producing fruit and self-seeding. No. 39732.

Veronica peregrina L. Neckweed. In waste and cultivated ground. Nos. 36442, 36516.

Epifagus virginiana (L.) Bart. Beech Drops. On superficial roots of beech trees, south side of Hemlock Hill. No. 38185.

Plantago major L. Common Plantain. A common weed in waste ground. Nos. 39685, 39749, 40214.

**Galium asprellum* Michx. Rough Bedstraw. Moist weedy ground, South Street tract. Nos. 40251, 42678.

Houstonia caerulea L. Bluets. Among shrubs and laurel bushes, foot of Hemlock Hill, northeast side, and also one plant collected amongst laurels near South Street gate. Nos. 40260, 40270.

Diervilla Lonicera Mill. Bush Honeysuckle. Rocky open woods and ledges, Central and South Woods and slopes of Hemlock Hill. No. 36571.

**Lonicera alpigena* L. Rocky ground, south slope of Hemlock Hill. No. 36452.

**Lonicera dioica* L. Honeysuckle. Open woods, Oak group. No. 42216.

**Viburnum trilobum* Marsh. High-bush Cranberry. Woods near top of Peters Hill. No. 38246.

**Lagenaria leucantha* (Duch.) Rusby. GOURD. On dump, South Street tract. No. 42209.

Liatris scariosa Willd. BLAZING STAR. Open woods, low hills, Maple group. No. 42204. Rare.

Solidago ulmifolia Muhl. Open woods, South Street tract. No. 42206. There is also a specimen of this species in the herbarium of the New England Botanical Club, collected by *C. E. Faxon,* on "Bussey Mountain," Sept. 4, 1887.

Solidago odora Ait. SWEET GOLDEN-ROD. Open woods, slopes of Bussey Hill near Oak group and in South Woods. Nos. 38213, 39736. Rare.

**Boltonia asteroides* (L.) L'Her. In low weedy ground, South Street tract. No. 42211.

Aster multiflorus Ait. Dry open slopes, near top of Peters Hill. No. 38721.

Aster linariifolius L. f. *leucactis* Benke. Slopes of Peters Hill, in Crataegus group. A form with smaller heads and white rays, growing with the species. No. 29730.

Aster acuminatus Michx. Under shade of apple trees, on hillside northwest of Administration Building. No. 42213. Rare.

Antennaria plantaginifolia (L.) Richards. Dry grassy slopes and meadows. Nos. 36362, 36386, 36444. Common.

Antennaria canadensis Greene. Grassy slopes, gravelly soil, between Arborway wall and Shrub Collection, and also on slopes of Peters Hill. Nos. 36393, 40014.

Antennaria neglecta Greene. Dry open slopes of Peters Hill. Nos. 40014a, 40014b.

**Heliopsis helianthoides* (L.) Sweet. OX-EYE. Spreading from cultivation into open ground, near Dawson House. No. 42681.

**Helenium nudiflorum* Nutt. SNEEZEWEED. Open grassy ground, near South Street gate and also near Administration Building. Nos. 42205, 42655, 42680.

**Chrysanthemum segetum* L. CORN MARIGOLD. Waste ground and dump, field near Dawson House.

Senecio aureus L. GOLDEN RAGWORT. Moist shaded ground between Tilia group and bridle path, and also in Poplar group near Peters Hill. Nos. 36476, 36511.

**Senecio viscosus* L. CLAMMY GROUNDSEL. Waste and cultivated ground, South Street tract and Conifer group. Nos. 38232, 39750.

**Hypochaeris radicata* L. CAT'S-EAR. Grassy open ground northwest of Administration Building. No. 42672.

**Sonchus arvensis* L. var. *glabrescens* Guenth. Wimm. & Grab. Perennial Sow Thistle. Rich waste ground, near pond, South Street tract. Nos. 42665, 42691, 42699.

**Sonchus asper* (L.) Hill. Sow Thistle. Waste and cultivated ground. Nos. 35710, 35927. These numbers were listed through error as *Sonchus oleracea* in original list. Both species are found, and the latter has been collected under numbers 39739a and 40219.

**Crepis capillaris* (L.) Wallr. Hawk's Beard. Grassy open slopes near Administration Building and also along Meadow Road near Hemlock Hill. Nos. 42192, 42629, 42671.

**Lactuca scariola* L. Prickly Lettuce. Waste ground, South Street tract. No. 40245.

**Lactuca sagittifolia* Ell. Waste ground, South Street tract. No. 40244.

**Lactuca spicata* (Lam.) Hitchc. var. *integrifolia* (Gray) Britton. Open woods, Carya group. No. 39648.

**Hieracium florentinum* All. King Devil. Grassy slopes of Peters Hill in Crataegus group, near Roslindale Gate and in Celtis group. Nos. 36581, 39563, 40170, 40180.

**Hieracium vulgatum* Fries. Grassy open ground near Platanus nursery. No. 42795.

Herbarium, Arnold Arboretum,
Harvard University.

THE HOSTS OF GYMNOSPORANGIUM GLOBOSUM FARL. AND THEIR RELATIVE SUSCEPTIBILITY

J. D. MACLACHLAN

With plates 125 to 128 and four text-figures

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I. INTRODUCTION

GYMNOSPORANGIUM GLOBOSUM Farl., a heteroecious rust, is restricted in its telial phase to a limited number of species and varieties of *Juniperus*. To the aecial phase, however, representatives of at least ten genera within the Pomoideae may serve as hosts; and certain of these genera, especially *Crataegus*, include a large number of species and varieties.

In spite of the number of hosts hitherto reported for *G. globosum*, very little information is available regarding the relative susceptibility of the hosts. This is a question of considerable importance because of the great damage done by the rust. A determination of the immune species and the comparative resistance of susceptible species within the various relevant host genera constitute the major part of this paper.

Concurrently with the investigations which led to a determination of the relative susceptibility of the hosts, the writer was enabled to compile a more nearly complete list of the known hosts, from which it appears that, instead of the approximately one hundred hosts hitherto reported, the number of hosts should be conservatively estimated at more than six hundred. This list constitutes the latter portion of the paper.

The work on the problems outlined above has been carried on at the Arnold Arboretum of Harvard University, where may be found one of the finest collections in the world of living representatives of species and varieties of *Juniperus* and of the Pomoideae.

II. RELATIVE SUSCEPTIBILITY OF HOSTS WITHIN GENERA OF THE POMOIDEAE

HISTORY

The earliest successful attempt to determine pomaceous hosts of *G. globosum* Farl. by means of cultures may be credited to Farlow (1880) who, in 1876–7, using teliospores from *Juniperus virginiana*, obtained spermogonia on *Crataegus tomentosa*. Farlow (1885) also made successful cultures on leaves of *Crataegus Douglasii, Crataegus Oxyacantha*

and apple seedlings; but he obtained spermogonia only, because his experimental leaves molded before the aecial stage could develop. Thaxter (1887) obtained spermogonia on *Crataegus coccinea, Malus pumila, Sorbus americana,* and *Amelanchier canadensis;* and in 1887–8 (Thaxter, 1889) obtained spermogonia on *Sorbus americana* and *Cydonia oblonga* (= *Cydonia vulgaris*), and both spermogonia and aecia on *Crataegus coccinea* and *Malus pumila.* In a later report Thaxter (1891) confirmed the previous results on *Malus pumila* and records successful infections of *Crataegus crus-galli* and *Sorbus americana,* both resulting in aecial development. In 1906, cultures were made by Arthur (1907) on *Crataegus Pringlei* and *Sorbus americana* resulting in spermogonia and aecia, and on *Malus coronaria* giving spermogonia only. In 1908 Arthur (1909) confirmed his results on *Crataegus Pringlei,* and in 1909 (Arthur, 1910) those of Farlow on *Crataegus coccinea.*

Since Arthur's work more than one hundred suscepts have been added to the host list, mostly by observations made in the field. Authors who have contributed or made significant reference to this list include Clinton (1904 and 1934), Stewart (1910), Kern (1911), Stevens and Hall (1910), Arthur (1921, 1924, 1926 and 1927), Burnham and Latham (1917), Hesler and Whetzel (1917), Jackson (1921), Hunt (1926), Anonymous (1930), Thomas and Mills (1930), Sherbakoff (1932), and others. Bliss (1931), by culture, obtained abundant spermogonia and aecia on *Crataegus mollis,* but obtained only flecking on nine varieties of commercial apples.

These previous reports, together with the investigations made by the writer, warrant the conclusion that the genera involved as suscepts for the aecial phase of *G. globosum* are confined to the sub-family Pomoideae, and include *Amelanchier, Crataegus, Cydonia, Malus, Mespilus, Pyrus, Sorbus,* and the hybrid genera *Crataegomespilus, Sorbaronia* and *Sorbopyrus.*

METHODS USED TO DETERMINE SUSCEPTIBILITY

Two methods of approach were utilized in the determination of the various hosts and their relative susceptibility within each genus, namely, (1) quantitative observations on natural infection, and (2) serial artificial inoculations during the progressive development of the foliage to determine both the degree and the duration of the period of susceptibility. These methods of approach were especially applicable to *Crataegus* which is by far the largest genus susceptible to *G. globosum.* All cultures and observations were made on trees in the Arnold Arboretum.

CULTURAL TECHNIQUE

The cultural technique adopted was similar to that described by Crowell (1934). The inoculum was collected either the previous evening, or in the morning prior to inoculating, from *Juniperus virginiana*. Galls bearing abundant telial flanges were soaked in water until maximum swelling had taken place; then the gelatinous mass was crushed to form a thick aqueous suspension of teliospores. Fresh inoculum was prepared every two hours during inoculation in order to eliminate any possibility of crushing the promycelia emerging from the germinating teliospores, since microscopic examination revealed that the latter would germinate within that time. All inoculations were carried out in duplicate. For each test six to ten leaves on a twig were inoculated; the remainder of the tree served as a control. The spore suspension was painted on both sides of the leaves with a camel's hair brush; then a celluloid cylinder was slipped over the twig and the ends of the cylinder were plugged with moist sphagnum. Care was taken that the inoculation should not be exposed to direct rays of the sun; otherwise burning of the leaves within the cylinder might occur. The sphagnum-plugged cylinder formed an excellent moist chamber; on removal of the tube two days later the sphagnum was always found to be still wet, and both the inside of the tube and the surfaces of the leaves were moist. Thus, with a heavy sowing of spores, a moist atmosphere in the inoculation tube, and a temperature below 25°C. the conditions for optimum spore germination and infection exceeded any that might occur in nature. Plate 127 fig. 5 illustrates a type set-up.

RECORDING OF DATA OBTAINED FROM INOCULATIONS

In recording data the inoculated plants were classified according to four categories or degrees of susceptibility, based on the number of sori, their relative size, and the pathogenic effect on an average-sized leaf. They are designated and defined as follows:

0—Immune; no visible infection obtained.

1—Resistant; one to five lesions which are relatively small, which cause very little leaf killing and no leaf drop; with or without aecia. This is a type of infection which causes no material harm to the host.

2—Moderately Susceptible; five to twenty-five lesions per leaf with an intermediate pathogenic effect between categories 1 and 3; aecia always produced. This is a type of infection which, while reducing the photosynthetic leaf area and causing some leaf killing, does not result in defoliation.

3—VERY SUSCEPTIBLE; twenty-five or more lesions which are usually large or fuse to form large masses and which cause severe leaf killing and leaf drop; abundant aecial horns produced in each lesion. This is a type of infection which ruins the foliage.

While these definitions are, in general, applicable in allotting a suscept to any one category, they can not be considered as absolute criteria. Within the genus *Crataegus*, for example, as will be shown later in this paper, variation in susceptibility is for the most part not physiological but is dependent primarily upon a natural barrier, the cuticle; the probability that the basidiospore can produce infection varies inversely with the thickness of the foliar cuticle. Again, the amount of leaf killing is dependent upon whether infection takes place on main veins or elsewhere on the leaf. Consequently, for *Crataegus* at least, the actual number of lesions per average-sized leaf was given major significance. In other genera, the type of infection was accorded major consideration. In the genus *Pyrus*, for example, certain species exhibited very small lesions which died shortly after spermogonia appeared, while other species of this genus showed larger lesions producing aecia. In general, however, the foregoing definitions were employed as the bases for placing the various species within the different categories of susceptibility.

INVESTIGATIONS AND CONCLUSIONS WITH RESPECT TO THE VARIOUS GENERA CONSIDERED

For the sake of convenience the various host genera will be considered individually with respect to their relative susceptibility. All the known hosts within each genus will be listed at the end of the paper.

Crataegus

The Arnold Arboretum with almost one thousand trees comprising about five hundred and fifty named species and varieties, spread over twenty-four groups, afforded an excellent opportunity to study the relative susceptibility of the *Crataegi*. But, since the species of this genus hybridize so freely, and since the specific classification is still in an unstable condition, the time and labor involved in making inoculations for each of those species and varieties (especially in the large very susceptible groups where an abundance of natural infection was observed) would not justify the results that might be obtained; consequently typical representatives of each of the twenty-four groups were selected and the results were used as a basis of comparison by groups rather than by species. Likewise the data obtained on all the species and varieties by observations on natural infection were treated by groups rather than by species.

A. Presentation of Data Obtained by Observations on Natural Infection

In July, 1932, a general spread of *G. globosum* was observed throughout the entire plantation of *Crataegi* in the Arnold Arboretum.[1] Detailed observations were warranted by the fact that, within each group, the degree of infection was consistently uniform regardless of where the tree happened to be situated; likewise a sharp line of demarcation could be seen between the number of foliar lesions per tree in a relatively resistant group, such as the Crus-galli, and the number per tree in a more susceptible group, such as the Coccineae or Anomalae.

The amount of infection on any one tree while uniform was slight enough to allow fairly accurate counts to be made of the number of lesions per tree. While these data would hardly be adequate to permit comparison among species within any one group of *Crataegus,* they were sufficient for comparing the relative degree of susceptibility of the various groups represented in the Arboretum. As stated above, about one thousand trees were available for examination.

Observations were made at the spermogonial stage, and again at the aecial stage of the rust. In order that the amount of infection per tree might be fairly compared the trees were graded as to size, five size-classes being used.[1] Counts were made of the number of foliar lesions per tree at both stages of the rust; where the counts exceeded one hundred per tree, the degree of infection was termed "100+".[2] A collection of herbarium material was assembled for permanent reference.

In correlating the data obtained a method had to be devised by means of which a tree, for example size I, could be fairly compared with a tree, for example size V. The Coccineae, a group containing 46 species represented by 82 trees, exhibited the highest percentage of infection lesions per unit-sized tree. This group was classed as having severe infection, and the values obtained for this group were selected as a basis of com-

[1]This plantation is a pure, open stand situated on an exposed hillside; furthermore, the groups within the genus are arranged in contiguous blocks. Rust-infected cedars were so remote that there was undoubtedly a uniform distribution of inoculum over the *Crataegus* trees.

[1]The five size-classes were arbitrary gradings involving the relative amount of foliage as well as the actual tree size.

[2]A tree with "100+" lesions was considered as having 150 lesions. However, with the exception of those trees that were obviously very susceptible, such occurrences were so rare that deviation from this estimation would make no significant differences in the correlations.

parison for all the other groups. It was found that for the COCCINEAE:

Size I (9 trees) averaged 24.3 lesions per tree.
Size II (33 trees) averaged 51.7 lesions per tree.
Size III (35 trees) averaged 75.7 lesions per tree.
Size IV (5 trees) averaged 120.0 lesions per tree.
Size V (0 trees).[1]

If, for the sake of convenience, the ratio of the number of lesions per tree be changed from 24.3: 51.7: 75.7: 120.0: — to 25: 50: 75: 125: 200, for the respective tree sizes, and these values be considered as units for classifying a tree as having severe infection, then by taking arbitrary averages for the number of lesions required to class a tree as having moderate infection, mild infection, or no infection, the scheme as presented in Fig. 1 for classifying the trees of all the groups may be formulated.

	Number of lesions per tree within the respective tree sizes				
	I	II	III	IV	V
Severe infection .	25	50	75	125	200
	20	40	60	100	160
Moderate infection .	15	30	45	75	120
	10	20	30	50	80
Mild infection .	5	10	15	25	40
No infection .	0	0	0	0	0

FIG. 1. AN ARBITRARY SCHEME TO DETERMINE THE RELATIVE DEGREE OF INFECTION ON TREES OF DIFFERENT SIZES.

From this scheme any tree of any size with any number of lesions may be classified according to the relative amount of infection present. On a tree size I, for example, one to ten lesions would be classed as mild infection, ten to twenty as moderate infection, and more than twenty as severe infection. As may be noted in Fig. 1, the ratio of the average number of lesions for any sized tree for the four degrees of infection is 5: 3: 1: 0. If, then, we multiply the number of trees classed as having severe infection by 5, moderate infection by 3, mild infection by 1, and no infection by 0, take the total of these products and divide by the number of trees considered, a unit is obtained by which the relative susceptibility of any group may be fairly and quite accurately compared

[1]The COCCINEAE did not include any trees of size V; as a matter of fact there are only six trees of this size in the plantation. From actual measurements of the various tree sizes and from the table given above, it was estimated that a tree of size V must necessarily have at least 200 lesions to be classed as having severe infection.

with a similarly derived unit for any other group. To illustrate this, let us consider a moderately susceptible group, the MACRACANTHAE, and a resistant group, the CRUS-GALLI:

MACRACANTHAE (see Table II):

Severe infection ..	7 trees	× 5	=	35
Moderate infection ..	10 trees	× 3	=	30
Mild infection ..	78 trees	× 1	=	78
No infection ..	4 trees	× 0	=	0
Total ..	99 trees			143

$$\text{Susceptibility unit of comparison} = \frac{143}{99} = 1.44$$

CRUS-GALLI (see Table II):

Severe infection ..	0 trees	× 5	=	0
Moderate infection ..	2 trees	× 3	=	6
Mild infection ..	46 trees	× 1	=	46
No infection ..	80 trees	× 0	=	0
Total ..	128 trees			52

$$\text{Susceptibility unit of comparison} = \frac{52}{128} = 0.41$$

The groups of *Crataegus* examined, the number of species examined in each group and the number of trees representing these species, the numbers of trees classed according to the different degrees of infection, and finally the units of comparison, which may now be considered as the relative degrees of susceptibility as indicated by natural infection, are presented in Table II. These values for the degrees of susceptibility have been plotted in Fig. 4.

B. PRESENTATION OF DATA OBTAINED BY SERIAL INOCULATIONS

Serial artificial inoculations were made at the following stages in the foliar development: (a) on April 23 and 24, 1934, at which time very little foliage was evident, a few buds had begun to unfurl, the majority were just breaking through the winter scales, while in many instances it was necessary to part the winter scales and insert the inoculum; (b) on May 7 and 8, 1932 and 1934, respectively, at which times (the foliar conditions being approximately the same in both years) the leaves in practically all cases were in an advanced stage of expansion but were still tender, exhibiting relatively little cuticular development; (c) on May 22 and 23, 1933 and 1934, respectively, at which times the leaf

cuticle was fairly well developed and most of the trees were in an advanced stage of blossom;[1] (d) on June 28, 1934, when the foliage was, for all practical purposes, fully mature and certain of the groups exhibited a very heavy cuticle on the leaves.[2]

The number of species inoculated in each group and the percentage of these falling into the different classes of susceptibility for each of the four serial inoculations are presented in Table III. The correlation of these data will be found under sub-section D.

FIG. 2. DISTRIBUTION OF THE GENUS CRATAEGUS IN NORTH AMERICA.

[1]In certain groups, for example the CRUS-GALLI, differences could be observed in the type of foliage exhibited by two trees of the same species, in which case both were inoculated to determine if variation in susceptibility existed within a single species. Except in such instances totally different representatives were used in the respective years for inoculations (b) and (c).

[2]The inoculum for inoculations (c) and (d) had been kept in a refrigerator at 0°C., where, as will be shown in a subsequent publication, the teliospores will retain their viability to more than ninety percent germination for at least a year.

C. Factors Influencing the Relative Susceptibility of Crataegus

1. The geographical distribution of *Crataegus*

Of the twenty-nine groups as given by Rehder (1927), twenty-three are of American origin; the remainder have been introduced from Eurasia. With the exception of the Macracanthae, which extend into the middle west, and the Douglasianae, which are typically western, the American groups, as indicated by the dotted area in Fig. 2, are confined to the eastern part of North America. While certain of these groups are typically more northern than others they overlap to such an extent that no correlation could be made between the distribution and the relative susceptibility of the respective American groups. Although none of the Eurasian groups proved to be very susceptible, no differences from the type of infection produced on American groups could be observed. Consequently, the distribution of the genus gave no information that proved of value in determining the relative susceptibility of the various Crataegus groups.

2. The rôle of the foliar cuticle

By using herbarium material collected in the Arnold Arboretum from natural infection in 1932 a detailed comparison was made between one of the largest and most resistant groups, Crus-galli, and one of the largest and very susceptible groups, Tenuifoliae, in an attempt to correlate the susceptibility of the host plant with the mechanical structure of the leaf. As a check on the results obtained, the Coccineae, another very susceptible group, was examined in a similar manner. The following observations were made:

(a) Distribution of lesions on the leaf.
  i. Number of lesions primarily associated with mid and main lateral veins of the leaf.
  ii. Number of lesions on the chlorenchyma which, for present purposes, may be defined as the leaf area other than that occupied by the mid and main lateral veins.

(b) Spermogonial stage.
  i. Number of spermogonia per lesion.
  ii. Diameter of lesion.

(c) Aecial stage.
  i. Number of aecial horns per lesion.
  ii. Diameter of lesion producing aecia.
  iii. Length of mature aecial horns.
  iv. Number of lesions actually producing aecia.

(d) Detailed notes on thickness of foliar cuticle, degree of hypertrophy and amount of leaf-killing.

In addition to the above data separate measurements and counts were made for chlorenchyma and vein infections in the COCCINEAE. Table I gives the results obtained for these three groups.

TABLE I

PRESENTING DATA ON BIOMETRICS AS OBTAINED FROM HERBARIUM MATERIAL FOR THREE GROUPS OF THE CRATAEGI

Group	No. species	No. trees	No. leaves	No. lesions	% trees infected	% vein infections	Av. no. spermogonia per lesion	Av. diam. of lesion covered by spermogonia	Av. no. aecia per lesion	Av. diam. of lesion covered by aecia	Av. length of aecial horns	% of lesions bearing aecia
Crus-galli	76	121	2216	216	37	83	43	3.0	31	3.7	3.2	66
Tenuifoliae	83	183	1283	1361	96	47	25	2.0	21	3.0	2.5	90
Coccineae	42	75	638	717	97	31	16;33 25	1.7;2.7 2.2	18;32 25	2.2;3.8 3.0	2.3;2.5 2.4	100

Crus-galli = thick, coriaceous, waxy leaves. Tenuifoliae and Coccineae = thin, non-waxy leaves.

Within the COCCINEAE the pairs of values (separated by a semi-colon) refer to chlorenchyma and vein infections respectively; the averages are given below the pairs. All measurements were made to the nearest millimeter.

A comparison of these data brings out three significant facts:

(1) Practically all the CRUS-GALLI have thick coriaceous leaves with a very heavy cuticle. The TENUIFOLIAE and COCCINEAE, on the other hand, have thin leaves with little cuticle. This condition was checked for all the other groups, and while the thickness of the leaf itself did not show consistent correlation with the relative susceptibility of the respective groups, there was a surprisingly consistent correlation on the part of cuticular thickness. Groups that finally fell into the moderately susceptible class exhibited an intermediate deposition of cuticle, the degree of which varied somewhat in different species within the respective groups. All the species within the groups which were classed as resistant had consistently heavy cuticle and those classed as very susceptible had consistently little cuticle.

(2) The CRUS-GALLI leaves have more than eighty percent of the infections on veins, the TENUIFOLIAE approximately fifty percent and the COCCINEAE about thirty percent. By correlating these data with the relative susceptibility of the three groups, it appears that the degree of

susceptibility varies inversely as the percentage of infections primarily associated with the main veins.

(3) Although the CRUS-GALLI exhibit the lowest percentage of trees infected, and thus would seem the most resistant, the individual lesions on the leaves of this group have the greatest diameter, and the largest number of spermogonia and aecia per lesion.

When these facts are fitted into the picture of the relative susceptibility of any host tree to the rust, they definitely indicate that the difference in susceptibility is purely mechanical, the cuticle being the deciding factor. The basidiospores of *G. globosum,* while able to produce infection from the lower surface of the leaf, germinate and gain entrance primarily through the upper side. Thus, spores carried by the wind and alighting on the smooth waxy surface of the CRUS-GALLI leaf are not so liable to adhere, and if they do remain and germinate, a large percentage of the germ-tubes die before they can penetrate the heavy cuticle. Many instances illustrating this phenomenon occurred during investigations of the waxy-leaf types. Within the CRUS-GALLI, for example, a much higher degree of susceptibility relative to the groups with non-waxy leaves was indicated by artificial inoculation where conditions were optimum for the infection process, than by natural infection where the basidiospores must necessarily withstand a certain amount of desiccation before infection can take place. Again, in many cases waxy leaves infected by natural inoculation were found on very low branches only, that is, branches almost touching the ground. Here the leaves were kept cool and moist for longer periods of time by the tall grass that happened to be growing around these trees; such an environment afforded a better opportunity for spore germination and germ-tube penetration.

The distribution of lesions on the leaves gives further evidence of the cuticle acting as a natural barrier. In the CRUS-GALLI eighty-three percent of the lesions were primarily associated with the main veins. The little grooves over these veins afford lodging places for the basidiospores; moisture tends to remain longer along these areas, rendering a more favorable environment for the infection process. When making artificial inoculation by painting the leaves with an aqueous suspension of basidiospores, it was very difficult to get a film of the suspension to lie uniformly over waxy leaves. The water would form into droplets, and either roll off the leaf entirely or else remain in the little grooves over the veins. One can readily picture the same thing happening when the basidiospores are brought naturally. Inoculation usually takes place during wet weather, as it is then that the telial flanges on the galls swell and the teliospores germinate to produce basidiospores. The latter are

then carried aerially, either directly to the Crataegus leaf by the wind, or else washed out of the air by falling rain onto the host leaf. Here, as in the case of artificial inoculation, the moisture necessary for spore germination accumulates in droplets and these either roll off the waxy leaf or remain in the grooves over the veins, carrying the basidiospores with them.

With a non-waxy leaf we have an altogether different picture. A film of water readily spreads over the surface of the leaf in a uniform layer, in which case the basidiospores are more apt to remain where they happen to alight on the leaf. Here the germinating basidiospores have no heavy cuticle with which to contend and can successfully penetrate the leaf surface almost as easily at any place over the chlorenchyma as over the veins. Since the area occupied by chlorenchyma far exceeds that occupied by the main veins, one can readily see why only thirty-one percent of the lesions on the COCCINEAE leaves were vein infections as compared with eighty-three percent on the CRUS-GALLI leaves.

The fact that within the CRUS-GALLI group the rust flourished even better than within the more susceptible groups, producing larger lesions with a larger number of spermogonia and aecia per lesion, can also be attributed to the relatively high percentage of vein infections. Regardless of leaf type the very large lesions, some seven to ten millimeters long, with more than one hundred spermogonia and fifty to one hundred aecia per lesion, were vein infections. In the COCCINEAE measurements of vein and chlorenchyma infections were kept separate, in order to obtain quantitative data on the relative size of the lesions and the number of spermogonia and aecia per lesion in the two types of infection. As may be seen from the foregoing table, the lesions are much larger in vein infections, producing almost twice as many spermogonia and aecia. All evidences indicate that *G. globosum* is capable of establishing a much more efficient nutritional regime when in direct contact with one of the veins. In the early spermogonial stage of even chlorenchyma infections one can see yellowish lines of fungal hyphae, radiating out along the vascular bundles from the centre of the lesion, as shown in Plate 125, Fig. 2. Again, in Plate 125, Fig. 1, the infection appears systemic, extending the entire length of a lateral vein. Plate 125, Fig. 3 shows a main lateral vein infection branching out along one of the sub-lateral veins. In fact, in every vein infection observed (eight hundred and eighteen), as may be seen in Plate 125, Fig. 4, the lesion was typically long and narrow, the long axis corresponding with that of the vein.

Vein infections appeared to produce aecia later in the season than chlorenchyma infections. Many cases were found among the former where

the aecial horns were just emerging or else were very short when the leaves were collected, while nearly all the chlorenchyma lesions had fully developed aecia, with peridial cells ruptured and aeciospores emerging. It would seem, then, that the time of spore production is correlated with the availability of food supply. An infection not primarily associated with a main vein utilizes all the available nutrient and then produces spores. Vein infections, on the other hand, have a greater and more lasting nutrient supply from the host, develop more mycelium and, when they finally do sporulate, have a greater supply of reserve food to produce aecia. Thus chlorenchyma infections produce relatively smaller and fewer aecia over a smaller lesion and at an earlier date than vein infections. This fact would account for the higher percentage of the lesions within the TENUIFOLIAE and COCCINEAE actually producing aecia at the time the herbarium material was collected.

Severe leaf killing, where relatively few lesions per leaf were involved, was due in practically all cases to infections primarily associated with the main veins, the amount of leaf killing depending on how far back from the edge of the leaf the vein was attacked. Plate 126, Fig. 2 shows one lesion on the mid-vein resulting in the death of over half of the leaf. On the other hand, in Plate 126, Fig. 1, may be seen a chlorenchyma infection where leaf killing extends from the point of infection to the margin of the leaf but does not extend beyond the enclosing lateral veins. A purely chlorenchyma infection nearer the center of the leaf rarely causes killing beyond the area of actual infection.

If the degree of susceptibility is in any way physiological, one would necessarily expect that within the resistant groups the rust would have greater difficulty in establishing a satisfactory nutritional regime, and if once established would produce small lesions with relatively few fruiting bodies due to some antagonistic physiological reaction on the part of the host. Crowell (1934) found such to be the case when he determined the relative susceptibility of the genus *Malus* to *Gymnosporangium Juniperi-virginianae* Schw. In European species of *Malus* the lesions were very small, in some cases producing a few spermogonia but no aecia. Somewhat similar instances were found by the writer in determining the relative susceptibility of species of *Pyrus* to *G. globosum*. In the *Crataegi* a few rare instances were found that might suggest differential physiological antagonism on the part of the host. In Plate 126, Fig. 5 is shown a lesion that produced abundant spermogonia but died before any hypertrophy or production of aecia took place; the host tissue may have been hypersensitive to the rust mycelium, the latter taking such a heavy toll on the nutrient content of the leaf that the host tissue

was killed and as a result the fungus died. Plate 126, Fig. 4 illustrates a case of leaf killing extending below the area of infection; this suggests the existence of a toxic agent secreted by the rust. In a few of the collections very small lesions not more than a millimeter in diameter that never produced even spermogonia were found. In Plate 126, Fig. 3 may be seen a small lesion that exhibits no hypertrophy and produced only one aecial horn. However, such instances as the foregoing were rare and not consistent even on a single host, and may be considered as insignificant factors in determining the relative susceptibility of the genus *Crataegus*. Indeed, from examination of the herbarium material the writer found the exact opposite to any physiological antagonism on the part of the host to be true; *G. globosum* is apparently able to establish itself more satisfactorily in the most resistant groups, due to the relatively high percentage of vein infections. This condition would indicate that the basis for differences in susceptibility is for the most part mechanical, involving primarily the cuticle as the deciding factor. The CRUS-GALLI is a difficult group for the rust to invade, except for a very short period in the spring before the foliar cuticle has developed to any extent. However, once the rust has successfully penetrated this cuticle it is just as much at home and can do just as much damage or even more in the CRUS-GALLI than it can in the TENUIFOLIAE, COCCINEAE or any other very susceptible group.

3. The degree and the duration of the period of susceptibility

The rôle of the cuticle also explains the significant phase in the duration of the susceptibility of any host. There is a definite duration to this period of susceptibility for all the groups, the degree of which rises rapidly during the unfurling of the leaves and reaches a maximum during and immediately after the period of leaf expansion, then falls off gradually at a rate depending, in part at least, on the rapidity of deposition of foliar cuticle.

In PLATE 127, FIGS. 1–4 are shown the results obtained from the four respective serial inoculations on *Crataegus Pringlei*. At the time of initial inoculation, April 25, 1934, the leaves, approximately one quarter of an inch long, had just begun to unfurl and a very small amount of infection at the tip of one leaf resulted (Fig. 1). The inoculation on May 9, after the leaves had fairly well expanded, produced severe infection (Fig. 2). Inoculation two weeks later resulted in scattered lesions (Fig. 3), while the inoculation on June 28 gave negative results (Fig. 4).

The same phenomenon but from a different approach is evident in Plate 128, Figs. 1 and 2, which demonstrate the results obtained from inoculations on *Crataegus Jonesae* on May 7 and June 4 respectively.

All the leaves in both inoculations received approximately the same amount of inoculum per unit area of leaf. At the time of the first inoculation the five basal leaves were well expanded, while the two upper leaves were just beginning to expand. As may be noted in Fig. 1, much heavier infection occurred on the older leaves. (The large irregular white areas on the younger leaves are holes caused by insects.) In Fig. 2, showing the results of the later inoculation, the reverse situation is seen; on the younger leaves at the end of the twig abundant infection was obtained, while the older leaves exhibited only scattered lesions.

It is quite evident, therefore, that the cuticle cannot be the sole determining factor for variation in susceptibility throughout the entire life of the foliage; certain physiological factors may also be involved. For example, the leaves apparently are not so susceptible during the period of emergence from the winter scales until they are in a moderately advanced stage of expansion, a period prior to any heavy deposition of cuticle. It is possible that the rust is unable to establish itself in the very young leaf. However, since this rust is not primarily of a systemic nature, probably the dilution effect on the number of lesions resulting from the intussusceptional type of foliar growth and consequent expansion, as well as the relatively small leaf area exposed at the time of inoculation, will account for the major part of this phenomenon. Again, even the most susceptible groups, for example, ANOMALAE or COCCINEAE, are apparently quite resistant to the rust by the latter part of June, at which time the leaves have by no means the amount of cuticle that is formed on the CRUS-GALLI even in the early part of May. It is possible that the rust is unable to establish a nutritional regime in the mature leaf as exhibited in the latter part of June, a point in favor of assuming a physiological antagonism on the part of the host. The relatively high temperature may also be a factor, by inhibiting spore germination.

Nevertheless these two periods play an insignificant part in any determination of the amount of infection that may accumulate on a host, regardless of the group. In the former case the period is relatively short and the leaf area exposed to the basidiospores by the unfurling buds would be small in comparison with that exposed after the leaves have expanded. As for the latter case practically all the teliospores on the red cedar have germinated by May 25, and the degree of susceptibility of any pomaceous host after the last of May would have no significance in determining the amount of infection that might occur. Thus, for practical purposes in the field the significant period within which infection might take place is between the time the leaves are fairly well expanded

and the end of basidiospore dispersal. During this time the thickness and rapidity of deposition of the cuticle are the deciding factors. For this reason the inoculations in April and June, respectively, are not considered in determining the relative susceptibility of the various groups.

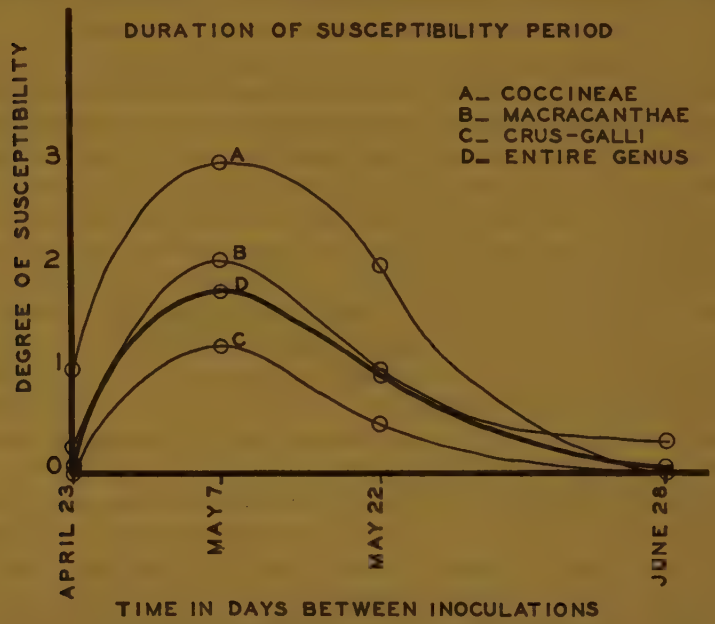

FIG. 3. ILLUSTRATING THE DEGREE AND THE DURATION OF THE PERIOD OF SUSCEPTIBILITY WITHIN THE GENUS CRATAEGUS TO G. GLOBOSUM.

To illustrate further the degree and duration of susceptibility within the different groups, values may be obtained for the relative degrees of susceptibility of the various groups by taking the sum total of the values as expressed by the symbols 0, 1, 2 and 3, and dividing by the number of representatives inoculated.[1] These were obtained from Table I for the COCCINEAE, MACRACANTHAE, and CRUS-GALLI, which are, respectively, typical of the classes very susceptible, moderately susceptible

[1]The objection arises that such a method of correlation utilizes arbitrary qualitative symbols to designate quantitative entities. Nevertheless, its usage here is not to be considered from a statistical standpoint and it does present a clearer picture to illustrate both the degree and the duration of the period of susceptibility within any one group of *Crataegus*. It is interesting to note that if such a method be employed in correlating the data obtained from serial inoculations in this genus (under sub-section D) one will arrive at precisely the same conclusions as in the method finally adopted.

and resistant, and have been plotted in Fig. 3. A similar curve (in heavy line) is given for all the inoculated representatives of the genus. The area enclosed by the respective curves would, to a certain extent, be a measure of both the degree of susceptibility and its duration. The

TABLE II

PRESENTING DATA ON THE RELATIVE SUSCEPTIBILITY OF CRATAEGUS TO G. GLOBOSUM, AS INDICATED BY NATURAL INFECTION

Group	No. Sps.	No. Trees	No. trees in the classes				Rel. degree of susceptibility
			No infect.	Mild infect.	Mod. infect.	Sev. infect.	
Anomalae	19	40	0	19	3	18	2.95
Azaroli	1	1	1	0	0	0	.00
Bracteatae	2	2	1	1	0	0	.50
Coccineae	46	82	2	24	20	36	3.22
Crus-galli	71	128	80	46	2	0	.41
Dilatatae	4	11	1	6	0	4	2.36
Douglasianae	8	19	3	16	0	0	.84
Flavae	10	11	11	0	0	0	.00
Intricatae	10	11	8	3	0	0	.27
Macracanthae	68	99	4	78	10	7	1.44
Microcarpae	1	1	1	0	0	0	.00
Molles	37	86	10	40	11	25	2.30
Nigrae	2	2	0	2	0	0	1.00
Oxycanthae	10	17	10	6	0	1	.65
Pinnatifidae	2	4	0	4	0	0	1.00
Pruinosae	58	98	36	57	3	2	.67
Punctatae	34	37	7	26	2	2	1.14
Rotundifoliae	37	66	14	37	8	7	1.45
Sanguinae	4	4	0	4	0	0	1.00
Silvicolae	35	57	3	42	8	4	1.51
Tenuifoliae	81	175	7	104	32	32	2.06
Triflorae	2	2	2	0	0	0	.00
Uniflorae	2	2	2	0	0	0	.00
Virides	18	30	20	9	1	0	.40

Coccineae, characterized by little foliar cuticle, exhibit a much higher degree of susceptibility over a relatively longer period of time than the Crus-galli which have consistently heavy cuticle on the leaves, whereas the Macracanthae, with an intermediate and varying amount of cuticle, assume an intermediate position.

D. CORRELATION OF THE DATA TO CLASSIFY THE GROUPS OF CRATAEGUS WITH RESPECT TO THEIR RELATIVE SUSCEPTIBILITY

Bearing in mind that the thickness of the cuticle and its rapidity of deposition on the leaves are the primary factors in determining the relative susceptibility of any host, while geographical distribution and physiological antagonism on the part of the host play a very minor part, if any, it is now possible to evaluate the data obtained by the two previously described methods of approach and determine the relative susceptibility of the various groups within the genus *Crataegus*.

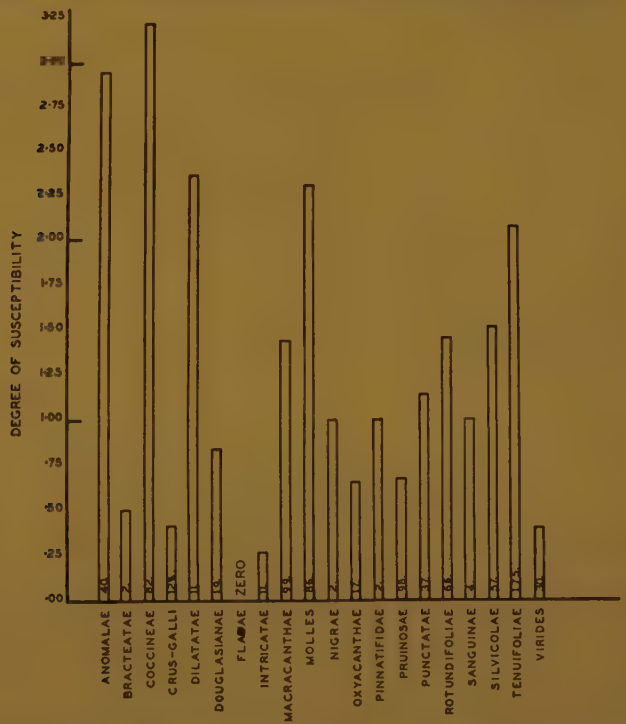

FIG. 4. RELATIVE SUSCEPTIBILITY OF THE GENUS CRATAEGUS TO G. GLOBOSUM AS INDICATED BY OBSERVATIONS ON NATURAL INFECTION. The number within each column refers to the number of trees considered within the group.

The relative degrees of susceptibility obtained from observations of natural infection, as previously stated, are presented in Table II, and have been plotted in Fig. 4. In regard to data obtained by serial inoculations, it is quite obvious from Table III that inoculations before the leaves unfurl, and again late in June, result in very little infection. However, as the foregoing discussion on the duration of the period of

susceptibility demonstrates, such a phenomenon, while interesting, plays an insignificant rôle in determining the amount of infection that might take place on any tree. The two significant inoculations are those made

TABLE III

PRESENTING DATA ON THE RELATIVE SUSCEPTIBILITY OF THE GENUS CRATAEGUS TO G. GLOBOSUM AS INDICATED BY SERIAL INOCULATIONS

Percentage of species within the various groups of Crataegus falling into the different classes of susceptibility, as indicated by serial artificial inoculations

(a)

Artificial inoculation April 23 and 24

Group	No. species	% species within classes 0	1	2	3
Anomalae	1	100.0	0.0	0.0	0.0
Bracteatae	1	100.0	0.0	0.0	0.0
Coccineae	2	0.0	100.0	0.0	0.0
Crus-galli	43	100.0	0.0	0.0	0.0
Dilatatae	0	-	-	-	-
Douglasianae	2	50.0	50.0	0.0	0.0
Flavae	6	100.0	0.0	0.0	0.0
Intricatae	5	100.0	0.0	0.0	0.0
Macracanthae	13	92.3	7.7	0.0	0.0
Microcarpae	1	100.0	0.0	0.0	0.0
Molles	6	83.3	16.7	0.0	0.0
Oxyacanthae	6	50.0	50.0	0.0	0.0
Pruinosae	30	96.7	3.3	0.0	0.0
Pulcherrimae	1	100.0	0.0	0.0	0.0
Punctatae	14	85.7	14.3	0.0	0.0
Rotundifoliae	8	87.5	12.5	0.0	0.0
Silvicolae	0	-	-	-	-
Tenuifoliae	5	40.0	60.0	0.0	0.0
Triflorae	2	100.0	0.0	0.0	0.0
Uniflorae	2	100.0	0.0	0.0	0.0
Virides	10	70.0	20.0	10.0	0.0

(b)

Artificial inoculation May 7 and 8

Group	No. species	% species within classes 0	1	2	3
Anomalae	7	0.0	0.0	85.7	14.3
Bracteatae	2	0.0	100.0	0.0	0.0
Coccineae	4	0.0	0.0	0.0	100.0
Crus-galli	48	25.0	39.6	22.9	12.5
Dilatatae	2	0.0	0.0	50.0	50.0
Douglasianae	3	0.0	0.0	66.7	33.3
Flavae	10	10.0	50.0	40.0	0.0
Intricatae	11	18.2	36.4	36.4	9.1
Macracanthae	20	15.0	10.0	30.0	45.0
Microcarpae	1	100.0	0.0	0.0	0.0
Molles	16	6.3	12.5	62.5	18.8
Oxyacanthae	6	0.0	66.7	33.3	0.0
Pruinosae	37	21.6	37.8	24.3	16.2
Pulcherrimae	1	100.0	0.0	0.0	0.0
Punctatae	18	5.5	16.7	38.9	38.9
Rotundifoliae	13	7.7	15.4	53.8	23.1
Silvicolae	4	25.0	50.0	0.0	25.0
Tenuifoliae	14	0.0	14.3	21.4	64.3
Triflorae	2	50.0	50.0	0.0	0.0
Uniflorae	2	0.0	100.0	0.0	0.0
Virides	13	0.0	30.7	23.1	46.1

(c)

Artificial inoculation May 22 and 23

Group	No. species	% species within classes 0	1	2	3
Anomalae	1	0.0	0.0	0.0	100.0
Bracteatae	2	0.0	100.0	0.0	0.0
Coccineae	4	0.0	0.0	100.0	0.0
Crus-galli	78	69.2	20.5	10.3	0.0
Dilatatae	0	-	-	-	-
Douglasianae	3	66.7	33.3	0.0	0.0
Flavae	11	18.2	54.6	27.3	0.0
Intricatae	8	12.5	62.5	25.0	0.0
Macracanthae	16	37.5	37.5	25.0	0.0
Microcarpae	1	100.0	0.0	0.0	0.0
Molles	9	77.7	11.1	11.1	0.0
Oxyacanthae	11	27.3	54.5	18.2	0.0
Pruinosae	43	32.6	34.9	23.3	9.3
Pulcherrimae	1	0.0	0.0	100.0	0.0
Punctatae	20	30.0	50.0	10.0	10.0
Rotundifoliae	12	25.0	58.3	16.7	0.0
Silvicolae	1	100.0	0.0	0.0	0.0
Tenuifoliae	14	22.2	44.4	11.1	22.2
Triflorae	2	100.0	0.0	0.0	0.0
Uniflorae	3	100.0	0.0	0.0	0.0
Virides	17	64.7	17.6	17.6	0.0

(d)

Artificial inoculation June 28

Group	No. species	% species within classes 0	1	2	3
Anomalae	1	100.0	0.0	0.0	0.0
Bracteatae	0	-	-	-	-
Coccineae	1	100.0	0.0	0.0	0.0
Crus-galli	23	100.0	0.0	0.0	0.0
Dilatatae	0	-	-	-	-
Douglasianae	1	100.0	0.0	0.0	0.0
Flavae	5	80.0	20.0	0.0	0.0
Intricatae	3	100.0	0.0	0.0	0.0
Macracanthae	6	83.3	0.0	16.7	0.0
Microcarpae	1	100.0	0.0	0.0	0.0
Molles	2	100.0	0.0	0.0	0.0
Oxyacanthae	5	100.0	0.0	0.0	0.0
Pruinosae	23	95.7	0.0	4.3	0.0
Pulcherrimae	1	0.0	0.0	100.0	0.0
Punctatae	18	87.5	0.0	12.5	0.0
Rotundifoliae	6	83.3	16.7	0.0	0.0
Silvicolae	0	-	-	-	-
Tenuifoliae	1	100.0	0.0	0.0	0.0
Triflorae	0	-	-	-	-
Uniflorae	0	-	-	-	-
Virides	5	100.0	0.0	0.0	0.0

in May, (b) and (c), and for fifteen of the major groups the percentage frequency of occurrence of inoculated representatives falling into the respective classes of susceptibility have been plotted in Fig. 5 (p. 118).

In comparing these tables and figures to make a final classification of the groups according to their relative susceptibility, one must remember that these results were obtained from two altogether different meth-

ods of approach. For those groups the representatives of which have a heavy cuticle, a much lower degree of susceptibility would be indicated by natural infection than by artificial inoculation where the amount of inoculum and the cultural environment are optimum. The number of representatives examined in each group, and especially for natural infection, must also be given consideration.

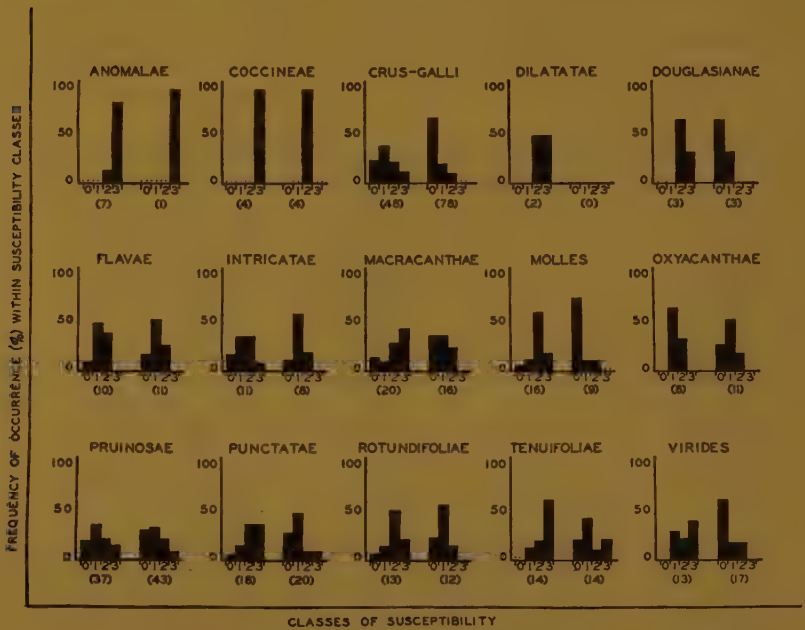

FIG. 5. RELATIVE SUSCEPTIBILITY OF FIFTEEN GROUPS OF THE GENUS CRATAEGUS TO G. GLOBOSUM AS INDICATED BY SERIAL INOCULATIONS. The results of two inoculations, (b) and (c) respectively, are presented in each sub-graph. The numbers on the abscissae of the sub-graphs refer to the classes of susceptibility. The numbers in parentheses refer to the number of species (with the exceptions noted in text) inoculated in each group.

By correlating the degree of susceptibility as indicated by natural infection, and the frequency of occurrence of inoculated representatives falling into the various classes of susceptibility, the groups may be classified and arranged within each class according to susceptibility as follows:[1]

Very susceptible—ANOMALAE, COCCINEAE, TENUIFOLIAE, DILATATAE.

[1]In classifying these groups according to their relative susceptibility, values for minor groups, not included in the figures, were taken directly from the tables.

Moderately susceptible—Molles, Macracanthae, Rotundifoliae, Punctatae, Douglasianae, Silvicolae, Pruinosae, Viridis, Flavae, Oxyacanthae, Intricatae.

Resistant—Crus-galli, Bracteatae, *Azaroli, *Microcarpae, *Nigrae, *Pinnatifidae, *Sanguineae, *Triflorae, *Uniflorae.[1]

Immune—None.

None of the groups examined proved to be wholly immune. No infection was obtained on the one representative of the Microcarpae, namely, *C. Phaenopyrum* (L. f.) Medic. (= *C. cordata* Ait.), but this species has been previously reported as a host to the rust from both Delaware and Tennessee. Of almost five hundred and fifty determined species and varieties studied, less than one percent of the artificial inoculations gave negative results and it is indeed possible that, given optimum conditions for germ-tube penetration, not a single species could be considered totally immune. However, as previously stated, it must be remembered that the conditions favorable for infection set up by artificial inoculation far exceed any that might occur in nature, and many species that are now classed as suscepts would probably never exhibit infection under field conditions.

E. Suggestions for the Selection of Resistant Species and Varieties

The best guide in the selection of Crataegus trees to be planted on estates where *G. globosum* is in the vicinity would be the thickness of the foliar cuticle. A striking example of this was found on an estate at Canton, Massachusetts, where two Crataegus trees, one a Coccineae species and the other a Crus-galli species, were planted side by side, surrounded by red cedars bearing heavy infections of *G. globosum*. These have been under observation for the past three years, and each season the foliage on the Coccineae species has suffered very severe infection, resulting in more than eighty percent defoliation by the latter part of August. The tree is now in a very weakened condition. The Crus-galli species, on the other hand, has been entirely unaffected by this rust.

In choosing from species of American origin one should definitely avoid the Anomalae, Coccineae, Tenuifoliae and Dilatatae if *G. globosum* be in the vicinity. Certain of the species within the groups

[1]The small number of representatives in the resistant groups indicated by asterisks made it impossible to arrange these groups within the class "Resistant" according to susceptibility and they have been arranged alphabetically.

classed as moderately susceptible have considerable cuticle on the leaves and these may be planted with a relative degree of safety. The CRUS-GALLI, however, are very resistant, and offer a wide variety of species. They are, as Rehder (1927) states, handsome ornamentals with dense, dark green foliage which remains till late in autumn or early winter, and are very attractive in bloom, with decorative bright red fruits that are persistent during the winter. If one desires the Eurasian type, the PINNATIFIDAE offer a group with lustrous leaves and large showy fruit. Some varieties of these are cultivated in northern China for the edible fruit. The OXYACANTHAE will also withstand severe infection unless under abnormal proximity to *Juniperus* rusted by *G. globosum*, with *C. Oxyacantha* Jacq. including some of the most showy garden forms.

This presentation has been confined to foliar lesions, and while infection has been obtained on all parts of the flower as well as the fruit and young twigs, such instances were sufficiently rare that they were not worthy of consideration at this time and have been set aside for a second publication on the life history of *G. globosum* Farl.

No consideration has been given to the possibility of variation in virulence within different strains of this rust. Practically all the inoculum was obtained from two adjacent red cedar trees at Waltham, Massachusetts.

One must also bear in mind that the relative susceptibility of groups within the genus *Crataegus* to *G. globosum* is in no respect correlated with their susceptibility to other *Gymnosporangium* rusts. Crowell (unpublished) has found, for example, that the CRUS-GALLI, so resistant to *G. globosum*, are quite susceptible to *G. clavipes* Cke. & Pk.

Pyrus — RELATIVE SUSCEPTIBILITY AS INDICATED BY SERIAL INOCULATIONS

Studies on relative susceptibility within the genus *Pyrus* were confined to the results obtained from serial inoculations made in 1934. The species represented in the Arboretum were artificially inoculated in a manner similar to that described for *Crataegus*: (a) on April 25, at which time the condition of the foliage varied from buds just bursting through the winter scales to leaves a quarter to a half inch long; (b) on May 9, when the leaves were fairly well expanded on all species; (c) on May 22 when the foliage was fully expanded; and (d) on June 28. Certain of the species which had given negative results in the previous inoculation were omitted in the June inoculation.

In Table IV are given the species inoculated, their distribution, the degree of infection obtained on the respective dates of inoculation, the

stages of the rust produced on the foliage, and finally, a classification of their relative susceptibility.

TABLE IV

PRESENTING DATA ON THE RELATIVE SUSCEPTIBILITY OF SPECIES OF THE GENUS PYRUS TO G. GLOBOSUM, AS INDICATED BY SERIAL INOCULATIONS

Species	Native distrib.	Deg. suscept. indicated by inoculations (a)	(b)	(c)	(d)	Stages found	Degree suscept.
P. Balansae Decne.	Eurasian	0	2	0	0	0 & 1	2
P. betulaefolia Bge.	Eurasian	3	3	2	0	0 & 1	3
P. Bretschneideri Rehd.	Eurasian	0	1	0	–	0 & 1	1
P. communis L.	Eurasian	0	1	0	–	0	1
P. elaeagrifolia Pall.	Eurasian	0	0	0	–		0
P. Korshinskyi Litv.	Eurasian	1	0	0	–	0	1
P. Michauxii Bosc.[1]	—	0	1	0	–	0	1
P. Lindleyi Rehd.	Eurasian	1	0	0	–	0	1
P. nivalis Jacq.	Eurasian	0	1	0	–	0	1
P. phaeocarpa Rehd.	Eurasian	0	1	1	0	0 & 1	1
P. salicifolia Pall.	Eurasian	0	0	0	–		0
P. serotina Rehd.	Eurasian	0	2	0	–	0 & 1	2
P. serrulata Rehd.	Eurasian	1	1	1	0	0	1
P. syriaca Boiss.	Eurasian	0	1	1	0	0 & 1	1
P. ussuriensis Maxim.	Eurasian	1	1	0	–	0 & 1	1

[1] *P. Michauxii* is a hybrid (*P. amygdaliformis* × *P. nivalis*).

No consistent correlation between the relative susceptibility of the various species and the type of leaf is evident; all species have considerable cuticle on the foliage, and a few are somewhat tomentose. Nor can the differences in susceptibility be correlated with the distribution of the host.

The lesions in general were found to be much smaller than those exhibited on *Crataegus*, and except in the case of *P. betulaefolia* rarely measured more than one to two millimeters in diameter. Certain species, designated in the table, showed spermogonia only; the lesions were extremely small, and died before any hypertrophy or aecial formation was evident. However, it is possible that with a different strain of the rust some of these might produce aecia; *P. communis*, for example, exhibited only spermogonia in my inoculations but has been reported previously from seven different states.

As in *Crataegus*, there is a definite duration to the period of susceptibility, the degree of which reaches its maximum during and immediately after the period of foliar growth and expansion, and then falls off gradually so that by the end of June all species examined are immune.

Classified according to their relative susceptibility, the species examined may be arranged (alphabetically) as follows:

Very susceptible—*P. betulaefolia* Bge.

Moderately susceptible—*P. Balansae* Decne., *P. serotina* Rehd.

Resistant—*P. Bretschneideri* Rehd., *P. communis* L., *P. Korshinskyi* Litv., × *P. Michauxii* Bosc, *P. Lindleyi* Rehd., *P. nivalis* Jacq., *P. phaeocarpa* Rehd., *P. serrulata* Rehd., *P. syriaca* Boiss., *P. ussuriensis* Maxim.

Immune—*P. amygdaliformis* Vill., *P. elaeagrifolia* Pall., *P. salicifolia* Pall.

Previous reports of *Pyrus* suscepts are confirmed, for the most part, to *P. communis,* to the Kieffer Pear (*P. communis* × *P. serotina*) and other varieties used commercially in the orchard. Stevens and Hall (1910) report *G. globosum* as being particularly abundant on the Japanese strain of pear (*P. serotina*), while Stewart (1910) reports the Kieffer pear as suffering infection from this rust at Long Island, New York. In particular he finds that both the fruit and leaves are attacked, and that the diseased fruits are very small and misshapen, usually exhibiting circular black areas devoid of aecia, although a few show aecia. On the other hand, Stewart (1910), and Hesler and Whetzel (1917) classify the Bartlett, Bosc, Duchess, and Worden varieties as being for the most part immune, although the fruit of the Worden variety is subject to infection.

While little can be added to the knowledge of the relative susceptibility of the orchard varieties, one may conclude from the foregoing classification that, with the exception of *P. betulaefolia, P. Balansae, P. serotina,* and as indicated from previous reports, *P. communis,* the remainder of the species can be safely planted in vicinities where the rust is present. This conclusion holds true especially for *P. amygdaliformis, P. elaeagrifolia,* and *P. salicifolia.*

Sorbus — Relative Susceptibility as Indicated by Serial Inoculations

Serial artificial inoculations were made in 1934 on species and varieties of *Sorbus* available in the Arnold Arboretum: (a) on April 25, at which time the foliar buds were just beginning to break open and the tiny leaves in many cases exhibited a heavy tomentose covering which was removed without injury to the leaf by rubbing the latter between the fingers, and the inoculum was placed on the exposed green tissue; (b) on May 9, at which time practically all the foliage was going through a period of rapid growth and expansion; (c) on May 24, at which time the leaves were fully expanded (blossoms where present were

also inoculated); (d) on June 28, at which time the leaves for all practical purposes were mature.

The results of these inoculations appear in Table V which presents, where positive results were obtained, the species and varieties inoculated, their native distribution, the degree of infection obtained from the respective inoculations, the stages of the rust exhibited, and finally the resultant classes of susceptibility.

TABLE V

PRESENTING DATA ON THE RELATIVE SUSCEPTIBILITY OF SPECIES AND VARIETIES OF THE GENUS SORBUS TO G. GLOBOSUM, AS INDICATED BY SERIAL INOCULATIONS

Species and varieties	Native distrib.	Deg. suscept. indicated by inoculations (a)	(b)	(c)	(d)	Stages found	Degree suscept.
S. americana Marsh.	American	1	3	2	0	0 & 1	3
S. americana var. fructu albo Hort.	American	1	1	0	–	0 & 1	1
S. americana var. nana Hort.	American	1	0	0	–	0	1
S. arnoldiana Rehd.[1]	Eurasian	1	1	0	–	0	1
S. Aucuparia var. Backhousei Hort.	Eurasian	1	0	0	–	0	1
S. dumosa Greene	American	1	0	0	–	0	1
S. japonica var. calocarpa Rehd.	Eurasian	1	0	0	–	0	1
S. thuringiaca Fritsch[2]	Eurasian	1	1	0	–	0 & 1	1

[1] *S. arnoldiana* is a hybrid (*S. Aucuparia* × *S. discolor*).
[2] *S. thuringiaca* is a hybrid (*S. Aucuparia* × *S. Aria*).

No infection was obtained on the following (alphabetically arranged) species and varieties, which are all of Eurasian origin: *Sorbus alnifolia* K. Koch, *S. amurensis* Koehne, *S. Aria* Crantz, *S. Aria* var. *angustifolia* Hort., *S. Aria* var. *Decaisneana* Rehd., *S. Aria* var. *longifolia* Pers., *S. Aria* var. *lutescens* Hartwig, *S. Aria* var. *magnifica* Hort., *S. Aria* var. *salicifolia* Myrin, *S. Aria* var. *sulphurea* Hort., *S. Aria* var. *theophrasta* Hort., *S. Aucuparia* L., *S. Aucuparia* var. *Dirkenii aurea* Hort., *S. Aucuparia* var. *edulis* Dieck, *S. Aucuparia* var. *nana* Hort., *S. Aucuparia* var. *xanthocarpa* Hartw. & Ruempl., *S. commixta* Hedl., *S. commixta* var. *rufo-ferruginea* Schneid., *S. discolor* Hedl., × *S. hybrida* L., *S. intermedia* Pers., × *S. latifolia* Pers., *S. latifolia* var. *atrovirens* Hort., *S. Matsumurana* Koehne, × *S. Meinichii* Hedl., *S. pohuashanensis* Hedl., *S. Zahlbruckneri* Schneid.

All species of American origin that were inoculated proved to be susceptible, with *S. americana* as the only species on which the foliage was materially injured by the rust. Of the thirty-one inoculated Eurasian types, infection was obtained on only four, and these proved to be quite resistant.

The lesions in all cases were very small, rarely measuring more than one to two millimeters in diameter, with an average of three to five aecial horns per sorus. Those species on which spermogonia only were obtained (see Table V) exhibited bright yellow lesions until the spermogonia were mature, following which time no further development took place and the infections died. An interesting type of natural infection was observed on Mt. Monadnock in New Hampshire; the lesions were as large as any ever obtained on *Crataegus,* some being as much as ten to twelve millimeters long, each bearing abundant aecial horns. Whether this type of infection results from a more susceptible variety of *S. americana,* or another strain of *G. globosum,* is not known.

With the exception of *S. americana,* no infection was obtained on any of the species after the second inoculation, while practically all the suscepts exhibited some infection from the initial inoculation. It would seem, therefore, that the resistant forms at least are most susceptible during, and immediately after, the period when the foliar buds are unfurling; *S. americana,* however, reached its maximum degree of susceptibility immediately after the leaves had expanded.

It is extremely doubtful that, with the exception of *S. americana* and its varieties within the American types, and possibly the hybrid Eurasian type, *S. thuringiaca,* any representative of the genus *Sorbus* would be seriously affected by *G. globosum* regardless of proximity to the rust. This is certainly true for the species of Eurasian origin.

Malus— Relative Susceptibility as Indicated by Serial Inoculations

Serial artificial inoculations were made in 1934, similar to those described for the preceding genera: (a) on April 24, at which time the leaves had already unfurled and were undergoing the period of rapid expansion; (b) on May 9, at which time the foliage was almost mature size, and most of the blossoms were in the pink stage; (c) on May 22, at which time most of the petals had dropped. No inoculation was made in June. Table VI presents the species on which positive results were obtained, the origin of the various species, the results obtained from the respective serial inoculations, the stages of the rust obtained, and finally the relative degree of susceptibility.

TABLE VI

PRESENTING DATA ON THE RELATIVE SUSCEPTIBILITY OF SPECIES AND VARIETIES OF THE GENUS MALUS TO G. GLOBOSUM, AS INDICATED BY SERIAL INOCULATIONS

Species and varieties	Native distrib.	Deg. suscept. indicated by inoculations (a)	(b)	(c)	Stages found	Degree suscept.
M. astracanica Dum.-Cours.[1]	Eurasian	0	1	0	0 & 1	1
M. baccata Borkh.	Eurasian	1	2	0	0 & 1	2
M. coronaria Mill.	American	0	1	0	0	1
M. Dawsoniana Rehd.[2]	Hybrid	0	1	1	0 & 1	1
M. glabrata Rehd.	American	0	1	0	0 & 1	1
M. ioensis var. plena Rehd.	American	1	2	1	0 & 1	2
M. magdeburgensis Schoch[3]	Eurasian	0	1	0	0	1
M. Soulardi Britt.[4]	Hybrid	–	2	0	0 & 1	2
M. sublobata Rehd.[5]	Eurasian	0	1	0	0 & 1	1

[1] *M. astracanica* is a hybrid (*M. prunifolia* × *M. pumila*).
[2] *M. Dawsoniana* is a hybrid (*M. fusca* × *M. pumila*).
[3] *M. magdeburgensis* is a hybrid (*M. pumila* × *M. spectabilis*).
[4] *M. Soulardi* is a hybrid (*M. ioensis* × *M. pumila*).
[5] *M. sublobata* is a hybrid (*M. prunifolia* × *M. Sieboldii*).

The following species, alphabetically arranged according to distribution, gave negative results:

American distribution: *Malus angustifolia* Michx., *M. bracteata* Rehd., *M. fusca* Schneid., *M. glaucescens* Rehd., *M. ioensis* Britt., *M. lancifolia* Rehd., *M. platycarpa* Rehd.

Eurasian distribution: × *Malus arnoldiana* Sarg., *M. asiatica* Nakai, × *M. atrosanguinea* Schneid., *M. brevipes* Rehd., *M. florentina* Schneid., *M. floribunda* Sieb., *M. Halliana* var. *Parkmanii* Rehd., × *M. Hartwigii* Koehne, *M. honanensis* Rehd., *M. kansuensis* Schneid., *M. micromalus* Mak., *M. hupehensis* (Pamp.) Rehd. (= *M. theifera* Rehd.), *M. pumila* Mill., *M. prunifolia* Borkh., × *M. purpurea* var. *Eleyi* Rehd., × *M. robusta* Rehd., *M. Sargenti* Rehd., *M. Sieboldii* Rehd., *M. sikkimensis* Koehne, *M. spectabilis* Borkh., *M. sylvestris* Mill., *M. toringoides* Hughes, *M. Tschonoskii* Schneid., *M. yunnanensis* var. *Veitchii* Rehd., × *M. zumi* Rehd.

A variety of an American species, *M. ioensis* var. *plena*, and the hybrid *M. Soulardi* proved to be moderately susceptible to *G. globosum*, while two species, *M. coronaria*, and *M. glabrata*, and the hybrid *M. Dawsoniana*, may be classed as mildly susceptible. On the remainder of the American species inoculated no infection could be observed; nevertheless, Thaxter (1889) obtained aecia on *M. pumila* Mill. (= *M.*

Malus Britt.). Of all the Eurasian species inoculated only one proved to be moderately susceptible, namely *M. baccata,* and three hybrids between Eurasian species, *M. astracanica, M. magdeburgensis* and *M. sublobata,* proved to be mildly susceptible.

Although a higher percentage of the American species proved to be susceptible, no outstanding correlation could be observed between relative susceptibility and geographic distribution. Nor can susceptibility be correlated with the type of leaf or type of infection produced. In all cases the lesions were small; they were rarely more than one to two millimeters in diameter.

The serial inoculations indicated a definite duration to the period of susceptibility which reaches a maximum about the time the blossoms are in the pink stage, and falls off to almost zero within a period of two weeks.

Excluding the species found to be susceptible it is very doubtful that any of the remaining species considered would suffer from the rust regardless of proximity to red cedars infected by *G. globosum.*

Previous reports would indicate that the commercial varieties of apple are more susceptible than the above ornamental types. Bliss (1931) using telial material from Iowa culturally obtained flecking on the varieties Baldwin, Delicious, Fameuse, Greening, McIntosh, Tolman, Wealthy, Yellow Transparent, and York Imperial. From reports of Clinton (1934), Thomas and Mills (1930), Sherbakoff (1932), Miller, Stevens and Wood (1933), and others, the relative susceptibility of the commercial varieties of apple may be classified as follows:

Varieties on which moderate to severe infection has been observed: Fallawater, Fameuse, Hubbardston, Northwestern Greening, Rhode Island Greening, and Wealthy.

Varieties reported susceptible: Baldwin, Cortland, Esopus, Spitzenburg, Fall Pippin, Gano, Golden Delicious, Jonathan, McIntosh, Newton, Northern Spy, Pewaukee, Rome Beauty, Russett, Stark, Tolman Sweet, Tompkins King, Wagener, Winesap, and York Imperial.

Resistant variety: Ben Davis.

Amelanchier[1]

Farlow (1885) obtained spermogonia on leaves of *Amelanchier canadensis* Med. and Harshberger (1902) lists the same species as a suscept to *G. globosum,* exhibiting both spermogonia and aecia. Stone (1908) lists *A. alnifolia*[2] as a suscept from Alabama. The following species and

[1]Relative susceptibility in this and the following genera was determined by non-serial inoculations.

[2]This probably refers to *A. canadensis* or *A. laevis,* since *A. alnifolia* is not native in Alabama.

varieties of *Amelanchier* were inoculated early in May, 1933: *Amelanchier amabilis* Wieg., *A. asiatica* Endl., *A. Bartramiana* Roem., *A. Bartramiana* × *A. laevis*, *A. canadensis* Med., *A. florida* Lindl., × *A. grandiflora* Rehd., *A. humilis* Wieg., *A. humilis* × *A. sanguinea*, *A. intermedia* Spach, *A. laevis* Wieg., *A. oblongifolia* Roem., *A. ovalis* Med., *A. sanguinea* DC., *A. sera* Ashe, *A. spicata* K. Koch, *A. stolonifera* Wieg. All the inoculations gave negative results.

No reports can be found indicating that any of the species and varieties of *Amelanchier* are very susceptible to *G. globosum*.

Cydonia

Thaxter (1888) by culture obtained spermogonia on *Cydonia oblonga* Mill. (= *C. vulgaris* Pers.). Cook (1913) reports *G. globosum* as being of common occurrence on quince in New Jersey. Harshberger (1902), Clinton (1904), and Güssow (1915) report this rust on quince from two other states and from the Niagara Peninsula. *Cydonia oblonga*, inoculated by the writer in early May, 1933, proved to be moderately susceptible to *G. globosum*, producing both spermogonia and aecia. None of the varieties of *Cydonia oblonga* was inoculated, and no information can be given with respect to their relative susceptibility.

The remaining smaller genera were artificially inoculated and the results from these inoculations may be summarized and tabulated as follows:

Comptonia

Comptonia asplenifolia Ait.—immune.

Crataegomespilus

Crataegomespilus grandiflora Bean (*Crataegus Oxyacantha* × *Mespilus germanica*)—very suceptible; both spermogonia and aecia obtained; severe leaf killing resulted. Natural infection was also observed.

Mespilus

Mespilus germanica L.—moderately susceptible; both spermogonia and aecia obtained.

Myrica

Myrica caroliniensis Mill.—immune. *M. Gale* L.—immune.

Photinia

Photinia villosa DC.—immune.

Sorbaronia

Sorbaronia alpina Schneid. f. *superaria* Zabel (*Aronia arbutifolia* ×

Sorbus Aria)—resistant; exhibited spermogonia only. *Aronia floribunda* × *Sorbus Aucuparia*—no infection obtained.

Sorbopyrus

Sorbopyrus auricularis Schneid. (*Pyrus communis* × *Sorbus Aria*)—resistant; exhibited spermogonia only.

III. RELATIVE SUSCEPTIBILITY OF HOSTS WITHIN THE GENUS JUNIPERUS

To our present knowledge of the relative susceptibility of *Juniperus* little can be added by the writer. From previous reports, including those of Adams (1919), Arthur (1926) (1927), Bliss (1933), Claassen (1897), Connors (1934), Hunt (1926), Kern (1929), Martin (1922) (1925), Stone (1909), and others, and from an examination of the material in the Farlow Herbarium and the herbarium of Professor J. H. Faull, the host list includes at least six species of *Juniperus,* and at least four varieties of *Juniperus virginiana.* These have been presented in the subsequent host list.

It may be added here that Martin (1922) lists *Larix* species as hosts to *G. globosum* from nine states. No infection by this rust has ever been observed on *Larix* in the Arnold Arboretum.

Juniperus virginiana is the most common telial host throughout the eastern and central part of North America, having been reported from twenty-five states and from Ontario. Severe infection may occur, as exemplified at the Morton Arboretum, Lisle, Illinois and from many estates and nurseries surrounding Boston. The writer has observed trees that were killed by the abundance of galls present. Other trees, while not killed, were disfigured to such an extent that they were no longer of ornamental value and had to be removed. *Juniperus scopulorum* has also been reported as suffering from infection by *G. globosum* at the Morton Arboretum.

As far as the eastern and central part of North America are concerned no information to date would indicate that any species other than *Juniperus virginiana* and *Juniperus scopulorum* and their varieties would suffer to any extent from infection by *G. globosum.*

IV. THE HOSTS OF GYMNOSPORANGIUM GLOBOSUM FARL.

The following list includes as far as can be ascertained all the known hosts of *G. globosum.* The hosts have been arranged alphabetically by genera and their included species. Within the genus *Crataegus* the species and varieties have been arranged within their respective groups.

Following each host name in parentheses are symbols which may be defined as follows:

a—as obtained by inoculations made by the writer; the inclusion of an author's name and reference indicates that this host has been determined previously by inoculation.

n—as determined by observations of natural infection made by the writer.

The inclusion of the abbreviated name of a State implies that this species has been reported previously as a host from that State.

All new hosts submitted would necessarily be records for the State of Massachusetts, as all studies were made in the Arnold Arboretum, Boston.

HOSTS FOR THE 0 & 1 STAGE

An asterisk preceding a host indicates that the 0 stage only was found.

AMELANCHIER:

Amelanchier alnifolia Nutt. (Ala.),[1] *A. canadensis* Med. (Thaxter [1885]; Penn.).

CRATAEGOMESPILUS:

Crataegomespilus grandiflora Bean (a; n).

CRATAEGUS (by groups):

ANOMALAE:

Crataegus affinis Sarg. (a; n), *C. asperifolia* Sarg. (a; n; Vt.), *C. Brockwayae* Sarg. (a; n), *C. Coleae* Sarg. (n), *C. cyclophylla* Sarg. (a; n; Vt.), *C. Dunbari* Sarg. (a; n), *C. Egglestonii* Sarg. (a; n; N. Y., Vt.), *C. errata* Sarg. (a; n), *C. honesta* Sarg. (n), *C. Ideae* Sarg. (n), *C. improvisa* Sarg. (n), *C. misella* Sarg. (n), *C. pinguis* Sarg. (n; Mich.), *C. putata* Sarg. (n), *C. repulsans* Sarg. (n), *C. Saundersiana* Sarg. (n), *C. scabrida* Sarg. (a; n; Vt.), *C. shirleyensis* Sarg. (a; n), *C. urbana* Sarg. (n).

AZAROLI:

Crataegus Heldreichii Boiss. (a), *C. tanacetifolia* Pers. (N. Y.).

BRACTEATAE:

Crataegus Ashei Beadle (a; n), *C. Harbisonii* Beadle (a; Tenn.).

COCCINEAE:

Crataegus acclivis Sarg. (n), *C. arcuata* Ashe (n; Penn.), *C. assurgens* Sarg. (a; n), *C. aulica* Sarg. (n), *C. caesa* Ashe (n), *C. chippewaensis* Sarg. (n), *C. confinis* Sarg. (n), *C. conspecta* Sarg. (n),

[1]See foot-note on page 126.

C. contigua Sarg. (n), *C. cristata* Ashe (n), *C. Dayana* Sarg. (n), *C. delecta* Sarg. (n; Ill.), *C. densiflora* Sarg. (n), *C. Eamesii* Sarg. (n; Conn.), *C. elongata* Sarg. (n), *C. fluviatilis* Sarg. (a; n), *C. fretalis* Sarg. (n; Conn.), *C. Hillii* Sarg. (n), *C. Holmesiana* Ashe (a; n; Conn., N. Y., Vt.), *C. Holmesiana* var. *tardipes* Sarg. (n), *C. Holmesiana* var. *villipes* Ashe (n), *C. irrasa* Sarg. (n), *C. lenta* Ashe (n), *C. lobulata* Sarg. (n), *C. Macounii* Sarg. (n), *C. miranda* Sarg. (n), *C. neolondinensis* Sarg. (n; Conn.), *C. pedicellata* Sarg. (a; n), *C. pedicellata* var. *gloriosa* Sarg. (n), *C. perrara* Sarg. (n), *C. polita* Sarg. (n; previously reported, state not given), *C. polita* var. *Tatnalliana* (Sarg.) Eggl. (Mo., N. Y.), *C. Pringlei* Sarg. (a, Arthur [1907]; n; Conn., Ind., N. Y.), *C. pura* Sarg. (n), *C. sejuncta* Sarg. (n), *C. sertata* Sarg. (n), *C. Thayeri* Sarg. (n), *C. uticaensis* Sarg. (n), *C. vivida* Sarg. (n).

CRUS-GALLI:

Crataegus algens Beadle (a; n), *C. arborea* Beadle (a; n), *C. arduennae* Sarg. (a; n; Ind.), *C. armata* Beadle (a), *C. arta* Beadle (a), *C. attenuata* Ashe (a; n), *C. barbata* Sarg. (a), *C. barrettiana* Sarg. (a), *C. Bartramiana* Sarg. (a), *C. bellica* Sarg. (a), *C. calophylla* Sarg. (a), *C. Canbyi* Sarg. (a; n), *C. cerasina* Sarg. (n), *C. consueta* Sarg. (a; Mo.), *C. crus-galli* L. (a, Thaxter [1891]: n; Ind., Ky., Maine, Mass., Miss., Mo., N. Car., Ohio, Penn., Tenn., Va.), *C. crus-galli* var. *arbutifolia* Hort. (a), *C. crus-galli* var. *exigua* (Sarg.) Eggl. (n), *C. crus-galli* var. *pyracanthifolia* Ait. (a; n), *C. crus-galli* var. *rubens* Sarg. (a), *C. efferta* Sarg. (a), *C. effulgens* Sarg. (a), *C. Engelmannii* Sarg. (a; n; Mo.), *C. erecta* Sarg. (a; n), *C. Farwellii* Sarg. (a; n), *C. fecunda* Sarg. (n), *C. Fontanesiana* (Spach) Steud. (a; n), *C. geneseensis* Sarg. (a), *C. hamata* Sarg. (a), *C. hirtella* Sarg. (a), *C. infesta* Sarg. (a; n), *C. insignis* Sarg. (a), *C. jasperensis* Sarg. (a), × *C. Lavallei* Herincq (a; n), *C. lawrencensis* Sarg. (a), *C. leptophylla* Sarg. (a; n), *C. livoniana* Sarg. (a; n), *C. macra* Beadle (a), *C. Mohrii* Beadle (a; n; Ga.), *C. munita* Sarg. (a), *C. pachyphylla* Sarg. (a), *C. Palmeri* Sarg. (a; n), *C. paradoxa* Sarg. (a), *C. parciflora* Sarg. (a; n), *C. Parkae* Sarg. (a), *C. Pennypackeri* Sarg. (a; n), *C. peoriensis* Sarg. (n), *C. permera* Sarg. (a; n), *C. persimilis* Sarg. (n), *C. persistens* Sarg. (a; n), *C. phlebodia* Sarg. (a; n), *C. pilifera* Sarg. (a), *C. polyclada* Sarg. (a), *C. regalis* Beadle (a; n), *C. Reverchonii* Sarg. (Tex.), *C. rivalis* Sarg. (a; n), *C. robusta* Sarg. (a; n), *C. rotunda* Sarg. (a), *C. rubrifolia* Sarg. (a; n), *C. rudis* Sarg. (a), *C. setosa* Sarg. (a), *C. severa* Sarg. (a), *C. signata*

Beadle (a), *C. sinistra* Beadle (a), *C. sublobulata* Sarg. (a; n), *C. tardiflora* Sarg. (a), *C. tetrica* Beadle (a; Tenn.), *C. triumphalis* Sarg. (a; n), *C. uniqua* Sarg. (a), *C. vallicola* Sarg. (a; n), *C. villiflora* Sarg. (a), *C. Wilkinsoni* Ashe (a).

DILATATAE:

Crataegus coccinioides Ashe (a; n; Mo.), *C. dilatata* Sarg. (= *C. coccinioides* var. *dilatata* [Sarg.] Eggl.) (a; Mass., N. Y., Penn., Vt.), *C. durobrivensis* Sarg. (n), *C. hudsonica* Sarg. (n).

DOUGLASIANAE:

Crataegus colorado Ashe (n), *C. columbiana* Howell (a), *C. Douglasii* Lindl. (a, Farlow [1885]; n), *C. Douglasii* f. *badia* Sarg. (n), *C. Douglasii* var. *Suksdorfii* Sarg. (n), *C. erythropoda* Ashe (n), *C. Piperi* Britt. (a), *C. rivularis* Nutt. (n).

FLAVAE:

Crataegus arrogans Beadle (a), *C. colonica* Beadle (a), *C. dispar* Beadle (a; S. Car.), *C. elliptica* Ait. (a), *C. frugiferens* Beadle (a), *C. ignava* Beadle (a; n), *C. impar* Beadle (a), *C. insidiosa* Beadle (a), *C. limata* Beadle (a), *C. visenda* Beadle (a).

INTRICATAE:

Crataegus apposita var. *Bissellii* (Sarg.) Eggl. (a; Conn.), *C. biltmoreana* Beadle (Mo.), *C. Boyntonii* Beadle (N. Car.), *C. Buckleyi* Beadle (a; N. Car.), *C. Delosii* Sarg. (a), *C. foetida* Ashe (a), *C. fortunata* Sarg. (a), *C. laetifica* Sarg. (a; n), *C. macilenta* Beadle (Ala.), *C. modesta* Sarg. (a), *C. neobushii* Sarg. (n), *C. Painteriana* Sarg. (a; n), *C. rubella* Beadle (a), *C. Sargentii* Beadle (a), *C. scabra* Sarg. (a; n), *C. Schweinitziana* Sarg. (Penn.), *C. straminea* Beadle (Penn.), *C. tecta* Beadle (Ala.), *C. villicarpa* Sarg.

MACRACANTHAE:

Crataegus ambrosia Sarg. (n), *C. aquilonaris* Sarg. (n), *C. ardua* Sarg. (n), *C. baccata* Sarg. (n), *C. Balkwillii* Sarg. (n), *C. Beckiana* Sarg. (n), *C. bristolensis* Sarg. (n), *C. calpodendron* (Ehrh.) Medic. (Penn.), *C. chadfordiana* Sarg. (n), *C. Chapmanii* (Beadle) Ashe (a; n; N. Car.), *C. conspecta* Sarg. (n), *C. conspicua* Sarg. (n; Vt.), *C. corporea* Sarg. (n), *C. delectabilis* Sarg. (Ont.), *C. Deweyana* Sarg. (a; n), *C. divida* Sarg. (n), *C. dumicola* Sarg. (n), *C. Emersoniana* Sarg. (a; n), *C. ferentaria* Sarg. (a; n), *C. ferta* Sarg. (n), *C. fertilis* Sarg. (a; n), *C. finitima* Sarg. (a; n), *C. flagrans* Sarg. (n), *C. flammea* Sarg. (n), *C. frutescens* Sarg. (n), *C. fulgens* Sarg. (a; n), *C. fulgida* Sarg. (n), *C. Gaultii* Sarg.

(a; n), *C. gemmosa* Sarg. (n), *C. glabrata* Sarg. (n), *C. globosa* Sarg. (a; n), *C. Halliana* Sarg. (n), *C. hystricina* Ashe (n), *C. illinoiensis* Ashe (n), *C. integriloba* Sarg. (n), *C. Laneyi* Sarg. (a; n), *C. laurentiana* Sarg. (n), *C. macracantha* Lodd. (a; n; Conn., N. Y., S. Dak., W. Va., Wis.), *C. macracantha* var. *succulenta* Rehd. (= *C. succulenta* Schrad.) (n; Penn., Wis.), *C. membranacea* Sarg. (n; Vt.), *C. michiganensis* Ashe (n), *C. microsperma* Sarg. (n), *C. missouriensis* Ashe (a; n), *C. neofluvialis* Ashe (n; Penn.), *C. nuda* Sarg. (n), *C. ogdensburgensis* Sarg. (n), *C. Peckietta* Sarg. (N. Y.), *C. pellucidula* Sarg. (n), *C. peramoena* Sarg. (n), *C. pertomentosa* Ashe (Iowa, Kansas), *C. pisifera* Sarg. (n; Vt.), *C. praeclara* Sarg. (a), *C. propixa* Sarg. (a), *C. prunifolia* (Marsh.) Pers. (a; n), *C. pudens* Sarg. (a; n), *C. rhombifolia* Sarg. (n; Conn., N. Y., Mass., Vt.), *C. Robinsonii* Sarg. (n), *C. rupicola* Sarg. (a), *C. saeva* Sarg. (n), *C. Searsii* Sarg. (n), *C. simulata* Sarg. (n), *C. spatiosa* Sarg. (n), *C. spinulosa* Sarg. (a; n), *C. structilis* Ashe (n), *C. tomentosa* L. (a, Thaxter [1880]; n; Ill., Iowa, Ky., Maine, Miss., Mo., Ohio, Ont., Que., Wis.), *C. truculenta* Sarg. (n), *C. vaga* Sarg. (a; n), *C. vegeta* Sarg. (a; n), *C. venulosa* Sarg. (a; n), *C. venustula* Sarg. (n), *C. Wilsonii* Sarg. (n).

MACROSPERMAE:

Crataegus Handyae Sarg. (n).

MICROCARPAE:

Crataegus Phaenopyrum (L. f.) Medic. (= *C. cordata* Ait.) (Del., Tenn.).

MOLLES:

Crataegus anomala Sarg. (n; Conn., N. Y.), *C. arnoldiana* Sarg. (a; n), *C. Berlandieri* Sarg. (n), *C. canadensis* Sarg. (n), *C. champlainensis* Sarg. (a; n; N. Y.), *C. contortifolia* Sarg. (n), *C. corusca* Sarg. (Ill.), *C. digna* Sarg. (n), *C. dispessa* Ashe (a; Mo.), *C. dumetosa* Sarg. (a; Mo.), *C. Ellwangeriana* Sarg. (a; n), *C. exclusa* Sarg. (n), *C. Fulleriana* Sarg. (n), *C. Greggiana* Eggl. (a), *C. induta* Sarg. (a), *C. invisa* Sarg. (n), *C. lanigera* Sarg. (n), *C. lanuginosa* Sarg. (a; n), *C. lasiantha* Sarg. (a; n; Mo.), *C. lauta* Sarg. (n), *C. limaria* Sarg. (a; n), *C. macrophylla* Sarg. (n), *C. meridionalis* Sarg. (n), *C. mollipes* Sarg. (n), *C. mollis* (Torr. & Gr.) Scheele (a, Bliss [1931]; n; Ill., Ind., Iowa, Kan., Ky., Mass., Mo., Nebr., Ohio), *C. noelensis* Sarg. (n), *C. nutans* Sarg. (n), *C. pennsylvanica* Ashe (n), *C. peregrina* Sarg. (a; n), *C. Robesoniana* Sarg. (n), *C. sera* Sarg. (a; n), *C. submollis* Sarg. (a; n; Vt.),

C. Tatnalliana Sarg. (n), *C. Tracyi* Ashe (a), *C. transmississippiensis* Sarg. (n), *C. Treleasei* Sarg. (Mo.), *C. umbrosa* Sarg. (n), *C. urbica* Sarg. (n).

NIGRAE:

× *Crataegus hiemalis* Lge. (n), *C. nigra* Kit. (n).

OXYACANTHAE:

Crataegus monogyna Jacq. (a; n; Mass.), *C. monogyna* var. *inermis* Rehd. (a), *C. monogyna* var. *laciniata* (Stev.) Regel (a; n), *C. monogyna* var. *pteridifolia* Rehd. (a; n), *C. Oxyacantha* L. a, Farlow [1885]; n; Maine, Mass., Ont.), *C. Oxyacantha* var. *Gireoudii* Bean (a), *C. Oxyacantha* var. *leucocarpa* Loudon (a), *C. Oxyacantha* var. *rubra* Hort. (a), × *C. sorbifolia* Lge. (a; n).

PINNATIFIDAE:

Crataegus pinnatifida Bge. (n), *C. pinnatifida* var. *major* N. E. Br. (n).

PRUINOSAE:

Crataegus alacris Sarg. (a), *C. amoena* Sarg. (a), *C. arcana* Beadle (n), *C. aridula* Sarg. (a), *C. aspera* Sarg. (a; n), *C. ater* Ashe (a), *C. beata* Sarg. (n), *C. bellula* Sarg. (n), *C. bracteata* Sarg. (a), *C. caerulescens* Sarg. (n), *C. cestrica* Sarg. (a), *C. Clintoniana* Sarg. (n), *C. cognata* Sarg. (n), *C. comata* Sarg. (n), *C. comparata* Sarg. (n), *C. confragosa* Sarg. (n), *C. conjuncta* Sarg. (a; n; Conn., Mass.), *C. delawarensis* Sarg. (a), *C. deltoides* Ashe (a; n), *C. disjuncta* Sarg. (a; Mo.), *C. divisifolia* Sarg. (n), *C. exornata* Sarg. (n), *C. Ferrissii* Ashe (n), *C. festiva* Sarg. (Conn., Vt.), *C. formosa* Sarg. (a; n), *C. fusca* Sarg. (a), *C. georgiana* Sarg. (a; n), *C. glareosa* Ashe (n), *C. horridula* Sarg. (a; n), *C. incisa* Sarg. (a; n), *C. inusitula* Sarg. (a; n), *C. iracunda* Beadle (a; n), *C. Jesupii* Sarg. (Penn.), *C. Kellermanii* Sarg. (a), *C. latifrons* Sarg. (n), *C. latisepala* Ashe (a; n), *C. leiophylla* Sarg. (a; n; N. Y.), *C. levis* Sarg. (a; n), *C. littoralis* Sarg. (a), *C. locuples* Sarg. (a; n), *C. numerosa* Sarg. (a; n), *C. oblita* Sarg. (a; n), *C. Pequotorum* Sarg. (a; n; Conn.), *C. perampla* Sarg. (a; n), *C. perjucunda* Sarg. (a), *C. philadelphica* Sarg. (a; n), *C. pilosa* Sarg. (n), *C. platycarpa* Sarg. (a), *C. Porteri* Britt. (n), *C. procera* Sarg. (a; n), *C. pruinosa* (Wendl.) K. Koch (a; n; Conn., Mo., N. Y., Ohio, S. Car., Penn.), *C. pruinosa* var. *latisepala* (Ashe) Eggl. (Mass., Mich.), *C. pulchra* Sarg. (a; n), *C. quinebaugensis* Sarg. (Conn.), *C. radiata* Sarg. (a; n), *C. relicta* Sarg. (n), *C. remota* Sarg. (n), *C. rubicundula* Sarg. (a; n), *C. scitula* Sarg.

(n), *C. sicca* Sarg. (n), *C. sitiens* Ashe (a; n), *C. tribulosa* Sarg. (n), *C. uplandia* Sarg. (n), *C. virella* Ashe (a).

PRUNIFOLIAE:

Crataegus decorata Sarg. (n; Mo.).

PULCHERRIMAE:

Crataegus ancisa Beadle (Ala.), *C. illustris* Beadle (a).

PUNCTATAE:

Crataegus amnicola Beadle (a; n), *C. angustata* Sarg. (a), *C. barbara* Sarg. (a; n), *C. Brownietta* Sarg. (n), *C. calvescens* Sarg. (n), *C. celsa* Sarg. (n), *C. collina* Chapm. (Ga., Va.), *C. compacta* Sarg. (n), *C. Dewingii* Sarg. (n), *C. Eatoniana* Sarg. (n), *C. Eastmaniana* Sarg. (a; n), *C. florifera* Sarg. (a; n), *C. glabrifolia* Sarg. (a; n), *C. incerta* Sarg. (n), *C. Lettermanii* Sarg. (a), *C. macropoda* Sarg. (a; n), *C. notabilis* Sarg. (n), *C. pausiaca* Ashe (a; n), *C. porrecta* Ashe (n), *C. praestans* Sarg. (a; n), *C. pratensis* Sarg. (a; n), *C. punctata* Jacq. (a; n; Ill., Ind., Iowa, Maine, Mass., Mich., Mo., N. Y., N. Car., Ohio, Ont. Penn., Vt., W. Va.), *C. punctata* var. *aurea* Ait. (a; n), *C. punctata* var. *canescens* Britt. (n), *C. punctata* var. *maliformis* ? (n), *C. punctata mutabilis* Gruber (a; n), *C. secta* Sarg. (a; n), *C. sordida* Sarg. (a), *C. suborbiculata* Sarg. (a; n), *C. succincta* Sarg. (a), *C. sucida* Sarg. (Mo.), *C. swanensis* Sarg. (a; n), *C. tenax* Ashe (a; n), *C. umbratilis* Sarg. (a; n), *C. verruculosa* Sarg. (n), *C. vicina* Sarg. (a).

ROTUNDIFOLIAE:

Crataegus Bicknellii Eggl. (n), *C. Blanchardii* Sarg. (n), *C. Brainerdii* Sarg. (a; n; Vt.), *C. Brunetiana* Sarg. (a), *C. caliciglabra* Schuette (a), *C. chrysocarpa* Ashe (N. Y.), *C. coccinata* Sarg. (n), *C. crassifolia* Sarg. (n), *C. cupulifera* Sarg. (n), *C. divergens* (Peck) Sarg. (a), *C. Dodgei* Ashe (n), *C. Evansiana* Sarg. (a; n), *C. Faxonii* Sarg. (n), *C. illuminata* Sarg. (n), *C. inaudita* Sarg. (a), *C. insolens* Sarg. (n), *C. Jackii* Sarg. (n), *C. Jonesae* Sarg. (a; n), *C. Keepii* Sarg. (n), *C. Kennedyi* Sarg. (n), *C. kingstonensis* Sarg. (n), *C. lemingtonensis* Sarg. (n), *C. maligna* Sarg. (n), *C. mansfieldensis* Sarg. (n), *C. Margaretta* Ashe (n; Iowa, Mo.), *C. Margaretta* f. *xanthocarpa* Sarg. (n), *C. Maribella* Sarg. (n), *C. Oakesiana* Eggl. (a), *C. praecoqua* Sarg. (= *C. praecox* Sarg.) (n; N. Y.), *C. Proctoriana* Sarg. (n), *C. propria* Sarg. (n), *C. rotundata* Sarg. (n), *C. rotundifolia* Moench (= *C. coccinea* L. p. p.) (a, Thaxter [1889]; n; Iowa, Mo., N. Y., Ont., Vt.), *C. rotundifolia* var.

aboriginum Sarg. (n), *C. rotundifolia* var. *pubera* Sarg. (n), *C. rotundifolia* f. *rubescens* Sarg. (n), *C. varians* Sarg. (n), *C. Websteri* Sarg. (n), *C. Williamsii* Eggl. (n).

SANGUINEAE:

Crataegus altaica Lange (n), *C. dsungarica* Zab. (n), × *C. Lambertiana* Lge. (n), *C. Maximowiczii* Schneid. (n), *C. sanguinea* Pall. (Ont.).

SILVICOLAE:

Crataegus aemula Beadle (n), *C. allecta* Sarg. (n), *C. Barryana* Sarg. (n), *C. blairensis* Sarg. (n), *C. congestiflora* Sarg. (a; n), *C. cruda* Sarg. (n), *C. delectata* Sarg. (n), *C. diffusa* Sarg. (= *C. silvicola* var. *Beckwithae* [Sarg.] Eggl.) (n; Conn., Vt.), *C. dissona* Sarg. (n; Mass., N. H., N. Y.), *C. effera* Sarg. (n), *C. filipes* Ashe (n), *C. foliata* Sarg. (n), *C. Fretzii* Sarg. (n), *C. gravis* Ashe (n), *C. iterata* Sarg. (n), *C. laetans* Sarg. (n), *C. Livingstoniana* Sarg. (n), *C. luxuriosa* Sarg. (n), *C. macera* Sarg. (n), *C. Maineana* Sarg. (n), *C. medioxima* Sarg. (n), *C. opulens* Sarg. (n), *C. promissa* Sarg. (a; n), *C. prona* Ashe (n), *C. puta* Sarg. (n), *C. radina* Sarg. (n), *C. recordabilis* Sarg. (n), *C. Robbinsiana* Sarg. (Vt.), *C. ruricola* Sarg. (n), *C. stolonifera* Sarg. (n), *C. strigosa* Sarg. (n), *C. tortuosa* Sarg. (n), *C. xanthophylla* Sarg. (a; n).

TENUIFOLIAE:

Crataegus acuminata Sarg. (a; n), *C. acutiloba* Sarg. (a; n; N. Y., Vt.), *C. alnorum* Sarg. (n), *C. apiomorpha* Sarg. (n), *C. ascendens* Sarg. (n), *C. asperata* Sarg. (n), *C. basilica* Beadle (a), *C. bella* Sarg. (a; n), *C. benigna* Sarg. (a; n), *C. blandita* Sarg. (n), *C. Boothiana* Sarg. (n), *C. colorata* Sarg. (a; n; Ont.), *C. conferta* Sarg. (n), *C. crudelis* Sarg. (n), *C. cyanophylla* Sarg. (a; n), *C. Damei* Sarg. (n), *C. delucida* Sarg. (n; Vt.), *C. demissa* Sarg. (n; Mass., Vt.), *C. dissimilis* Sarg. (a; n; Conn., Mass., Vt.), *C. Edsoni* Sarg. (n; N. H., Vt.), *C. Eganii* Ashe (n), *C. firma* Sarg. (n), *C. flabellata* (Bosc.) K. Koch (a; n), *C. florea* Sarg. (n), *C. Forbesae* Sarg. (a; n; Conn.), *C. fucosa* Sarg. (n), *C. genialis* Sarg. (a; n; Vt.), *C. glaucophylla* Sarg. (a; n; Conn., N. Y.), *C. gracilipes* Sarg. (n), *C. Gruberi* Ashe (n), *C. Habereri* Sarg. (n), *C. Hadleyana* Sarg. (n), *C. heidelbergensis* Sarg. (n), *C. insolita* Sarg. (n), *C. leptopoda* Sarg. (n), *C. lucorum* Sarg. (n), *C. luminosa* Sarg. (n), *C. macrosperma* Ashe (n; N. Y., Penn.), *C. marcida* Ashe (n), *C. matura* Sarg. (n), *C. media* Sarg. (n), *C. merita* Sarg. (n), *C. miniata* Ashe (n), *C. modica* Sarg. (n), *C. monstrata* Sarg. (n), *C. Napaea* Sarg. (n), *C. nescia* Sarg.

(n), *C. otiosa* Ashe (n), *C. Paddockeae* Sarg. (n), *C. Paineana* Sarg. (n), *C. pallidula* Sarg. (n), *C. parviflora* Sarg. (n), *C. pastorum* Sarg. (a; n), *C. paucispina* Sarg. (a), *C. pentandra* Sarg. (a; n; Vt.), *C. perlevis* Ashe (n), *C. populnea* Ashe (n), *C. pumila* Sarg. (n), *C. retrusa* Ashe (n), *C. roanensis* Ashe (Ky., Vt.), *C. rubicunda* Sarg. (n), *C. rubrocarnea* Sarg. (n), *C. rufipes* Ashe (n), *C. sarniensis* Sarg. (n), *C. saturata* Sarg. (n), *C. serena* Sarg. (n), *C. sextilis* Sarg. (n), *C. siderea* Sarg. (n), *C. Slavini* Sarg. (n), *C. Streeterae* Sarg. (n), *C. suavis* Sarg. (n), *C. taetrica* Sarg. (n), *C. tarda* Sarg. (n), *C. tenella* Ashe (n; Conn.), *C. tenera* Ashe (n), *C. tenuiloba* Sarg. (n), *C. trachyphylla* Sarg. (n), *C. uber* Ashe (n), *C. viridimontana* Sarg. (n), *C. vittata* Ashe (a).

TRIFLORAE:

Crataegus austromontana Beadle (a).

UNIFLORAE:

Crataegus armentalis Beadle (a), *C. Brittonii* Eggl. (a).

VIRIDES:

Crataegus abbreviata Sarg. (a; n), *C. atrorubens* Ashe (a; n), *C. blanda* Sarg. (a), *C. enucleata* Sarg. (a; n), *C. lanceolata* Sarg. (a; n), *C. larga* Sarg. (a), *C. lutensis* Sarg. (a), *C. nitens* Sarg. (a), *C. nitida* (Engelm.) Sarg. (a; n), *C. ovata* Sarg. (a; n), *C. penita* Beadle (a), *C. poliophylla* Sarg. (a), *C. uvaldensis* Sarg. (a), *C. velutina* Sarg. (a), *C. viridis* L. (a; n; Okla.), *C. vulsa* Beadle (a; n).

CYDONIA:

Cydonia oblonga Mill. (= *C. vulgaris* Pers.) (a; Thaxter [1889]; Conn., Niagara Peninsula, N. J., Penn.).

MALUS:

Malus angustifolia Michx. (S. Car.), × *M. astranica* Dum.-Cours. (a), *M. baccata* Borkh. (a), *M. coronaria* Mill. (a, Arthur [1907]), × *M. Dawsoniana* Rehd. (a), *M. glabrata* Rehd. (a), *M. glaucescens* Rehd. (Ind.), *M. ioensis* var. *plena* Rehd. (a), × **M. magdeburgensis* Schoch (a), *M. pumila* Mill. (= *M. Malus* [L.] Britt.) (Thaxter [1886]; Conn., Maine, Mass., Mo., N. H., N. J., N. Y., Vt.), × *M. Soulardi* Britt. (a), × *M. sublobata* Rehd. (a).

MESPILUS:

Mespilus germanica L. (a).

PYRUS:

Pyrus Balansae Decne. (a), *P. betulaefolia* Bge. (a; n), *P. Bretschneideri* Rehd. (a), *P. communis* L. (a; Conn., Ind., Iowa, Mass.,

N. Car., N. Y., Penn., R. I.), *P. elaeagrifolia* Pall. (a), **P. Korshinskyi* Litv. (a), **P. Michauxii* Bosc (a), **P. Lindleyi* Rehd. (a), **P. nivalis* Jacq. (a), *P. phaeocarpa* Rehd. (a), *P. salicifolia* Pall. (a), *P. serotina* Rehd. (a), **P. serrulata* Rehd. (a), *P. syriaca* Boiss. (a), *P. ussuriensis* Maxim. (a).

SORBARONIA:

× **Sorbaronia alpina* Schneid. f. *superaria* Zabel (a).

SORBOPYRUS:

× **Sorbopyrus auricularis* Schneid. (a).

SORBUS:

Sorbus americana Marsh. (a; Thaxter [1887 and 1891]; Maine, Mass., N. Y., Penn., Vt.), *S. americana* var. *fructu albo* Hort. (a), **S. americana* var. *nana* Hort. (a), × **S. arnoldiana* Rehd. (a), **S. Aucuparia* L. var. *Backhousei* Hort. (a), **S. dumosa* Greene (a), **S. japonica* var. *calocarpa* Rehd. (a), × *S. thuringiaca* Fritsch (a).

HOSTS FOR THE III STAGE

JUNIPERUS:

Juniperus lucayana Britt. (= *J. barbadensis* Auth., not L.) (Ala.), *J. communis* L. (Penn.), *J. fragrans* Hort. (Ont.), *J. horizontalis* Moench (= *J. prostrata* Pers.) (N. Dak.), *J. scopulorum* Sarg. (Colo., Ill., Iowa, N. Dak.), *J. virginiana* L. (Ala., Conn., Ill., Ind., Iowa, Kansas, Ky., La., Mass., Mich., Minn., Miss., Mo., N. H., N. Y., N. Car., N. Dak., Ohio, Okla., Ont., Penn., S. Car., Tex., Vt., W. Va., Wis.), *J. virginiana* var. *Burkii* Hort. (Ill.), *J. virginiana* var. *Canaertii* Sénécl. (Ill.), *J. virginiana* var. *elegantissima* Hochst. (Ill.), *J. virginiana* var. *glauca* Carr. (Ill.).

LARIX:

Larix sp. (Conn., Kan., Minn., Miss., N. Y., Okla., Tex., Va., W. Va.).

V. SUMMARY

1. At least ten genera, all within the Pomoideae, include hosts on which the aecial phase of *Gymnosporangium globosum* may occur. One genus only, *Juniperus,* is known with certainty to include hosts for the telial phase.

2. Relative susceptibility to *G. globosum* within the respective host genera has been studied by the writer to determine: (1) immune species; (2) resistant species which suffer no material harm from this rust; (3) moderately susceptible species which may be infected but not to the extent of defoliation; and (4) very susceptible species whose foliage can be ruined by *G. globosum.*

3. These investigations were carried out by means of artificial inoculations, substantiated by observations of natural infection where present, in the Arnold Arboretum of Harvard University.

4. The results of these investigations on relative susceptibility, added to those of previous writers, may be summarized as follows:

A. On host genera for the aecial phase of *G. globosum*.

(a) On the genera on which serial inoculations were made.

Crataegus. A marked variation in susceptibility was found within the genus, the degree of which is dependent primarily on the thickness and the rapidity of deposition of the foliar cuticle. Due to the large number of species and the unstable condition of taxonomy within the genus, the classification according to susceptibility to *G. globosum* was made by groups rather than by species. The observations on natural infection substantiated the results obtained by artificial inoculation. Suggestions have been made for the selection of resistant species and varieties within the respective groups.

Pyrus. Of seventeen species inoculated, one proved to be very susceptible, two moderately susceptible, ten resistant, and three immune. Certain of the commercial varieties are classified from previous reports according to their susceptibility to *G. globosum*.

Sorbus. Infection was obtained on all the species and varieties of American origin inoculated. Of thirty-one species and varieties of Eurasian origin inoculated four are resistant, the remainder are immune.

Malus. Of seven American species inoculated three proved to be susceptible, while infection was obtained on only one species and three hybrids of the twenty-seven Eurasian types considered. Infection was obtained also on two hybrids between Eurasian and American species. Certain of the commercial varieties are classified from previous reports according to their susceptibility to *G. globosum*.

(b) On the genera otherwise inoculated.

Amelanchier. Seventeen species and varieties were inoculated; all inoculations gave negative results. Nevertheless, the rust has been reported on two species, *A. canadensis* and *A. alnifolia*.[1] It is not probable that any species in this genus would suffer severely from infection by *G. globosum*.

Cydonia. *Gymnosporangium globosum* has been reported as occurring commonly on quince in New Jersey. *Cydonia oblonga* by culture proved to be moderately susceptible to *G. globosum*.

Crataegomespilus, *Mespilus*, *Sorbaronia* and *Sorbopyrus*. The re-

[1]See foot-note on page 53.

sults obtained by inoculations on representatives of these more or less susceptible genera have been tabulated on page 127.

Comptonia, Myrica and *Photinia.* These genera were found by inoculation to be immune.

B. Host genera for the telial phase of *G. globosum.*

Juniperus. No information to date would indicate that any species other than *J. virginiana* and *J. scopulorum* and their varieties would suffer to any extent from infection by *G. globosum.*

5. In the genera *Crataegus, Malus, Pyrus* and *Sorbus* there is a definite duration to the period of susceptibility reaching a maximum during or immediately after foliar expansion.

6. In selecting ornamentals to plant in vicinities where *Gymnosporangium* rusts are present, it must be remembered that the relative susceptibility of any host to *G. globosum* is not necessarily correlated with its susceptibility to other Gymnosporangium rusts.

7. No consideration has been given to the possibility of variation in virulence within different strains of *G. globosum.* Such may very well occur.

8. A complete list of all the known hosts of *G. globosum* is recorded in this paper.

VI. ACKNOWLEDGMENTS

To Professor J. H. Faull for his generous assistance in making this study possible and for his guidance, supervision and other expressions of personal interest the writer acknowledges deep obligation.

To the Arnold Arboretum for permission to use its facilities; to Professor A. Rehder and Mr. E. J. Palmer for their invaluable assistance in the taxonomic treatment of the host genera; to Dr. A. E. Navez for his careful analysis of data and for helpful advice; and to Dr. Ivan H. Crowell for his cooperation and his help in field work the writer also expresses gratitude.

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VIII. EXPLANATION OF PLATES

PLATE 125

Illustrations of the tendency of the mycelium to follow along the veins of Crataegus leaves:

Fig. 1. A series of lesions obtained by inoculation on a waxy-type of leaf (*Crataegus fecunda*), giving the appearance of systemic infection along the veins.
Fig. 2. A single lesion at the spermogonial stage on *Crataegus suavis*. The rust mycelium concentrates along the vascular strands causing the latter to show as bright yellow lines within the lesion.
Fig. 3. A single lesion extends along a lateral vein, forking at the junction with a sub-lateral vein.
Fig. 4. A typical vein infection; the long axis of the lesion corresponding with that of the vein.

PLATE 126

Types of infections and their resultant effects on Crataegus leaves (explanations in text):

Fig. 1. Illustrates the relative amount of leaf killing caused by vein infections, and by infections not primarily associated with the main veins.
Fig. 2. A single infection on the mid vein resulting in the death of over one-half of the leaf.
Fig. 3. A very small type of lesion, exhibiting no hypertrophy and producing a single aecial horn.
Fig. 4. A single vein infection (indicated by the black spot on the plate), killing the leaf behind the lesion along the vein; suggesting a toxic agent on the part of the rust.
Fig. 5. A large single lesion which died shortly after spermogonia appeared; suggesting hypersensitivity on the part of the host.

PLATE 127

Figs. 1, 2, 3 and 4, illustrate the relative degree of susceptibility of *Crataegus Pringlei,* as indicated by serial inoculations on April 25, May 9, May 23 and June 28, 1934, respectively.

Fig. 5. The type of chamber used in all the inoculations. (Explanations in the text.)

PLATE 128

Serial inoculations on *Crataegus Jonesae* to illustrate the period of susceptibility (explanations in text):

Fig. 1. Inoculated May 7, at which time the two upper leaves were very small, while the five basal leaves were well expanded. As indicated by the number of lesions the latter are the more susceptible.

Fig. 2. Inoculated June 8, at which time all leaves were fully expanded; the two upper (youngest) leaves are now the more susceptible.

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The Hosts of Gymnosporangium globosum Farl.

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THE HOSTS OF GYMNOSPORANGIUM GLOBOSUM Farl.

The Hosts of Gymnosporangium globosum Farl.

A PRELIMINARY NOTE ON LIFE HISTORY STUDIES OF EUROPEAN SPECIES OF MILESIA

LILLIAN M. HUNTER

Although eleven species of *Milesia* are known to occur in Europe (FAULL, J. H. Taxonomy and Geographical Distribution of the Genus Milesia. Contr. Arnold Arb. Harvard Univ. II. 1932) up to the present the life histories of two only of them have been worked out, namely, *M. Blechni* (Syd.) Arth. (KLEBAHN, H. Kulturversuche mit Rostpilzen. In Zeitsch. Pflanzenkr. **26**: 257–277. 1916) and *M. Kriegeriana* (Magn.) Arth. from *Dryopteris Filix mas* (L.) Schott (MAYOR, EUG. Notes Mycologiques VIII. In Bull. Soc. Neuchât. Sci. Nat. **58**: 23–26. 1933).

Recently it was my privilege to make certain investigations on life histories of *Milesia* rusts in England. Teliosporic material of several species was assembled and inoculation experiments were made on various firs with the results that spermogonia and aecia of the following species of *Milesia* have been obtained for the first time—

(1) *Milesia Scolopendrii* (Fuckel) Arth. (from *Scolopendrium vulgare* Smith) on *Abies alba* Mill., and *A. concolor* Lindl. and Gord.

(2) *Milesia Polypodii* B. White (from *Polypodium vulgare* L.) on *Abies alba* and *A. concolor*.

(3) *Milesia vogesiaca* (Syd.) Faull (from *Polystichum angulare* Presl) on *Abies alba*.

(4) *Milesia Kriegeriana* (Magn.) Arth. (from *Dryopteris spinulosa* [O. F. Müller] Kuntze) on *Abies alba, A. concolor* and *A. grandis* Lindl.

Spermogonia and aecia were also obtained for *Milesia Kriegeriana* (from *Dryopteris Filix mas*) on *Abies alba* and on two new hosts, namely, *A. concolor* and *A. grandis*.

Aeciospores thus obtained by cultures were used in inoculating various ferns, and uredospores were obtained for the following species—

(1) *Milesia Scolopendrii* on *Scolopendrium vulgare*.

(2) *Milesia Polypodii* on *Polypodium vulgare*.

(3a) *Milesia Kriegeriana* (from *Dryopteris spinulosa*) on *Dryopteris Filix mas, D. spinulosa* and *D. spinulosa* var. *intermedia* (Muhl.) Underw.

(3b) *Milesia Kriegeriana* (from *Dryopteris Filix mas*) on *Dryopteris Filix mas* and *D. spinulosa* var. *dilatata* (Hoffm.) Underw.

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